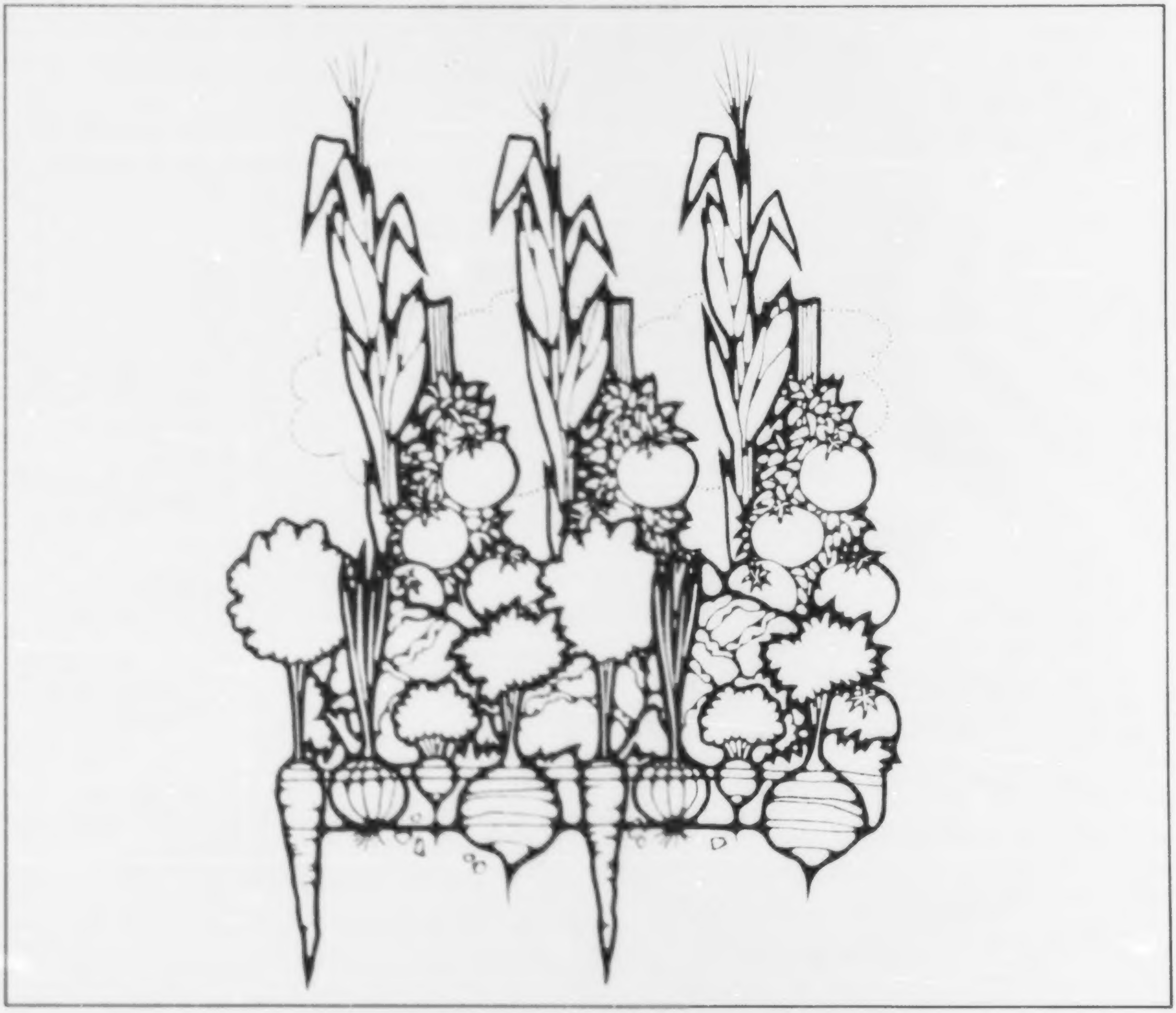
Manitoba
Agriculture

Agdex 250-32

Vegetable Crop Production Guide 1991-92



THIS PUBLICATION IS ONLY A GUIDE.
Always refer to the product label to check rates and additional precautions.
See your ag rep for periodic updates to this publication.

Conversion Table For Pesticide Rates Per Acre

To convert herbicide rate per hectare to rate per acre use the conversion table below:

L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre
0.00	0.00	2.00	0.81	4.00	1.62	6.00	2.43	8.00	3.24	10.00	4.05	12.00	4.86	14.00	5.67	16.00	6.48	18.00	7.28
0.05	0.02	2.05	0.83	4.05	1.64	6.05	2.45	8.05	3.26	10.05	4.07	12.05	4.88	14.05	5.69	16.05	6.50	19.00	7.69
0.10	0.04	2.10	0.85	4.10	1.66	6.10	2.47	8.10	3.28	10.10	4.09	12.10	4.90	14.10	5.71	16.10	6.52	20.00	8.09
0.15	0.06	2.15	0.87	4.15	1.68	6.15	2.49	8.15	3.30	10.15	4.11	12.15	4.92	14.15	5.73	16.15	6.54	21.00	8.50
0.20	0.08	2.20	0.89	4.20	1.70	6.20	2.51	8.20	3.32	10.20	4.13	12.20	4.94	14.20	5.75	16.20	6.56	22.00	8.90
0.25	0.10	2.25	0.91	4.25	1.72	6.25	2.53	8.25	3.34	10.25	4.15	12.25	4.96	14.25	5.77	16.25	6.58	23.00	9.30
0.30	0.12	2.30	0.93	4.30	1.74	6.30	2.55	8.30	3.36	10.30	4.17	12.30	4.98	14.30	5.79	16.30	6.60	24.00	9.71
0.35	0.14	2.35	0.95	4.35	1.76	6.35	2.57	8.35	3.38	10.35	4.19	12.35	5.00	14.35	5.81	16.35	6.62	25.00	10.12
0.40	0.16	2.40	0.97	4.40	1.78	6.40	2.59	8.40	3.40	10.40	4.21	12.40	5.02	14.40	5.83	16.40	6.64	26.00	10.52
0.45	0.18	2.45	0.99	4.45	1.80	6.45	2.61	8.45	3.42	10.45	4.23	12.45	5.04	14.45	5.85	16.45	6.66	27.00	10.93
0.50	0.20	2.50	1.01	4.50	1.82	6.50	2.63	8.50	3.44	10.50	4.25	12.50	5.06	14.50	5.87	16.50	6.68	28.00	11.33
0.55	0.22	2.55	1.03	4.55	1.84	6.55	2.65	8.55	3.46	10.55	4.27	12.55	5.08	14.55	5.89	16.55	6.70	29.00	11.74
0.60	0.24	2.60	1.05	4.60	1.86	6.60	2.67	8.60	3.48	10.60	4.29	12.60	5.10	14.60	5.91	16.60	6.72	30.00	12.14
0.65	0.26	2.65	1.07	4.65	1.88	6.65	2.69	8.65	3.50	10.65	4.31	12.65	5.12	14.65	5.93	16.65	6.74	31.00	12.55
0.70	0.28	2.70	1.09	4.70	1.90	6.70	2.71	8.70	3.52	10.70	4.33	12.70	5.14	14.70	5.95	16.70	5.76	32.00	12.95
0.75	0.30	2.75	1.11	4.75	1.92	6.75	2.73	8.75	3.54	10.75	4.35	12.75	5.16	14.75	5.97	16.75	6.78	33.00	13.36
0.80	0.32	2.80	1.13	4.80	1.94	6.80	2.75	8.80	3.56	10.80	4.37	12.80	5.18	14.80	5.99	16.80	6.80	34.00	13.75
0.85	0.34	2.85	1.15	4.85	1.96	6.85	2.77	8.85	3.58	10.85	4.39	12.85	5.20	14.85	6.01	16.85	6.82	35.00	14.16
0.90	0.36	2.90	1.17	4.90	1.98	6.90	2.79	8.90	3.60	10.90	4.41	12.90	5.22	14.90	6.03	16.90	6.84	36.00	14.57
0.95	0.38	2.95	1.19	4.95	2.00	6.95	2.81	8.95	3.62	10.95	4.43	12.95	5.24	14.95	6.05	16.95	6.86	37.00	14.97
1.00	0.40	3.00	1.21	5.00	2.02	7.00	2.83	9.00	3.64	11.00	4.45	13.00	5.26	15.00	6.07	17.00	6.88	38.00	15.38
1.05	0.42	3.05	1.23	5.05	2.04	7.05	2.85	9.05	3.66	11.05	4.47	13.05	5.28	15.05	6.09	17.05	6.90	39.00	15.78
1.10	0.45	3.10	1.25	5.10	2.06	7.10	2.87	9.10	3.68	11.10	4.49	13.10	5.30	15.10	6.11	17.10	6.92	40.00	16.19
1.15	0.47	3.15	1.27	5.15	2.08	7.15	2.89	9.15	3.70	11.15	4.51	13.15	5.32	15.15	6.13	17.15	6.94	41.00	16.59
1.20	0.49	3.20	1.30	5.20	2.10	7.20	2.91	9.20	3.72	11.20	4.53	13.20	5.34	15.20	6.15	17.20	6.96	42.00	17.00
1.25	0.51	3.25	1.32	5.25	2.12	7.25	2.93	9.25	3.74	11.25	4.55	13.25	5.36	15.25	6.17	17.25	6.98	43.00	17.40
1.30	0.53	3.30	1.34	5.30	2.14	7.30	2.95	9.30	3.76	11.30	4.57	13.30	5.38	15.30	6.19	17.30	7.00	44.00	17.81
1.35	0.55	3.35	1.36	5.35	2.17	7.35	2.97	9.35	3.78	11.35	4.59	13.35	5.40	15.35	6.21	17.35	7.02	45.00	18.21
1.40	0.57	3.40	1.38	5.40	2.19	7.40	2.99	9.40	3.80	11.40	4.61	13.40	5.42	15.40	6.23	17.40	7.04	46.00	18.62
1.45	0.59	3.45	1.40	5.45	2.21	7.45	3.02	9.45	3.82	11.45	4.63	13.45	5.44	15.45	6.25	17.45	7.06	47.00	19.02
1.50	0.61	3.50	1.42	5.50	2.23	7.50	3.04	9.50	3.84	11.50	4.65	13.50	5.46	15.50	6.27	17.50	7.08	48.00	19.43
1.55	0.63	3.55	1.44	5.55	2.25	7.55	3.06	9.55	3.86	11.55	4.67	13.55	5.48	15.55	6.29	17.55	7.10	49.00	19.83
1.60	0.65	3.60	1.46	5.60	2.27	7.60	3.08	9.60	3.89	11.60	4.69	13.60	5.50	15.60	6.31	17.60	7.12	50.00	20.24
1.65	0.67	3.65	1.48	5.65	2.29	7.65	3.10	9.65	3.91	11.65	4.71	13.65	5.52	15.65	6.33	17.65	7.14	60.00	24.28
1.70	0.69	3.70	1.50	5.70	2.31	7.70	3.12	9.70	3.93	11.70	4.74	13.70	5.54	15.70	6.35	17.70	7.16	70.00	28.33
1.75	0.71	3.75	1.52	5.75	2.33	7.75	3.14	9.75	3.95	11.75	4.76	13.75	5.56	15.75	6.37	17.75	7.18	80.00	32.38
1.80	0.73	3.80	1.54	5.80	2.35	7.80	3.16	9.80	3.97	11.80	4.78	13.80	5.58	15.80	6.39	17.80	7.20	90.00	36.42
1.85	0.75	3.85	1.56	5.85	2.37	7.85	3.18	9.85	3.99	11.85	4.80	13.85	5.61	15.85	6.41	17.85	7.22	100.00	40.47
1.90	0.77	3.90	1.58	5.90	2.39	7.90	3.20	9.90	4.01	11.90	4.82	13.90	5.63	15.90	6.43	17.90	7.24	110.00	44.52
1.95	0.79	3.95	1.60	5.95	2.41	7.95	3.22	9.95	4.03	11.95	4.84	13.95	5.65	15.95	6.45	17.95	7.26	120.00	48.56

Note: L/ha x 0.4047 = L/acre
kg/ha x 0.4047 = kg/acre

Example: 4.5 L/ha x 0.4047 = 1.82 L/acre

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ADDENDUM

VEGETABLE CROP PRODUCTION GUIDE - 1991

Weed Control

PRODUCT	CROP	WEEDS CONTROLLED	RATE (kg/ac)	DAYS TO HARVEST
Lentagran 45 WP Plus atrazine (post-emergent)	Sweet Corn	lambsquarters, wild mustard, redroot pigweed, purslane, common ragweed, smartweed, shepherdspurse	0.40 kg Lentagran + 0.40 kg **A.I.** atrazine	45
Lentagran 45WP plus metribuzin (post-emergent - directed)	Tomato	lambsquarters, wild mustard, redroot pigweed, purslane, common ragweed, smartweed, shepherdspurse	0.40 - 0.81 kg Lentagran plus 0.06-0.12 kg **A.I.** metribuzin	45

INSECT CONTROL

PRODUCT	CROP	INSECT CONTROLLED	RATE (L/ac)	DAYS TO HARVEST
Dibrom (864 g/L)	Broccoli, cabbage, cauliflower, brussel sprouts	Imported cabbage worm	0.45	4
		Diamond-back moth larvae	0.45	4
		Aphids	0.45	4
		cabbage looper	0.45 - 0.89	4
Dibrom (864 g/L)	Lettuce, celery, spinach	Looper Caterpillars	0.45 - 0.67	4
		Aphids	0.45 - 0.67	4
Dibrom (864 g/L)	Potato	Colorado Potato Beetle	0.45	4
		Leafhopper	0.45	4
		Flea beetle	0.45	4
Dibrom (864 g/L)	Onion (bulb or seed only)	Thrips	0.22	4
		Onion maggot flies	0.22	4
Dibrom (864 g/L)	Tomato	Hornworm	0.40	4
		Fruitworm	0.40	4
		Leafminers	0.40	4

NOTE: READ PRODUCT LABELS BEFORE USE

Vegetable Crop Production Guide 1991-92

The Vegetable Crop Production Guide provides the most up-to-date information on varieties, cultural techniques, harvest, storage and pest control measures for Manitoba production. The information is based on research and field experience.

This publication is prepared by Manitoba Agriculture in co-operation with the Plant Science Department, University of Manitoba.

Recommended rates of *pesticides (herbicides, insecticides and fungicides)* are given in L or kg/acre. Product labels provide rates only in metric units (L or kg per hectare). To avoid application errors, be sure to read and understand label recommendations. Be sure that the *concentration* of product you are using matches the concentration shown in this Guide.

If you wish to change the metric units from L or kg per hectare to L or kg per acre, multiply the rate in L or kg/ha given on the product label by 0.4 to obtain the rate in L or kg/acre. Or refer to the *conversion chart* on page 2.

If you are unsure about the correct amount of product to use, don't take a chance. Contact the provincial vegetable crop specialist at 239-3359, the provincial potato crop specialist at 945-3829 or the chemical company representative for clarification.

Measurements other than those indicated above are given in a dual system. Example — kilograms/hectare (lb./acre) of fertilizer.

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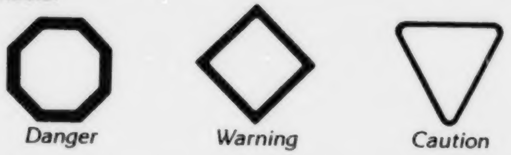
Pesticides

Pesticide Safety Symbols

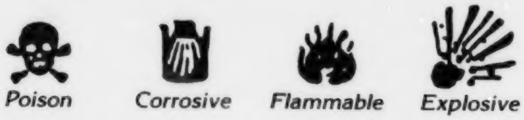
All pesticide container labels carry safety symbols indicating the degree of hazard and risk to the user.

The **categories of risk** are indicated by the following symbols:

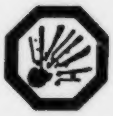


Products that are the most toxic and pose the highest risk to the user carry the **DANGER** symbol. **WARNING** and **CAUTION** are less dangerous, respectively. Where the risk is minimal, no symbol is required on the container label.

The **categories of hazard** are represented by the following symbols:

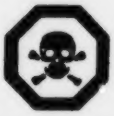


Categories of Risk symbols are used in conjunction with **Category of Hazard** symbols on product labels. For example, the following symbol would mean danger — explosive.



Because most pesticides are poisons, the remainder of this page explains the toxicity of the poison risk symbols and lists the type of safety equipment that should be worn by the user.

Poison Risk Symbols



Danger—Poison

***LD50** (see end of page for explanation):

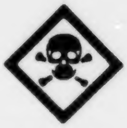
- oral, less than 500 mg/kg
- dermal, less than 1000 mg/kg

Probable Lethal Dose for 68 kg (150 lb.) person:

- 7 drops to 28 mL (1 oz.) swallowed
- 7 drops to 85 mL (3 oz.) absorbed

Safety Clothing To Be Worn:

Respirator, goggles, clean coveralls, water repellent hat, rubber gloves, rubber boots.



Warning—Poison

***LD50** (see below):

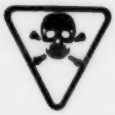
- oral, 500 - 1000 mg/kg
- dermal, 1000 - 2000 mg/kg

Probable Lethal Dose for 68 kg (150 lb) person:

- 28 to 85 mL (1 to 3 oz.) swallowed
- 85 to 200 mL (3 to 7 oz.) absorbed

Safety Clothing To Be Worn:

Goggles, clean coveralls, water repellent hat, rubber boots, rubber gloves.



Caution—Poison

***LD50** (see below):

- oral, 1000 - 2500 mg/kg
- dermal, 2000 - 5000 mg/kg

Probable Lethal Dose for 68 kg (150 lb.) person:

- 85 to 227 mL (3 to 8 oz.) swallowed
- 200 to 455 mL (7 to 16 oz.) absorbed

Safety Equipment To Be Worn:

Clean coveralls, water repellent hat, rubber boots, rubber gloves.

***LD50** — *a measure of toxicity that indicates the amount of pure pesticide that would produce a 50% mortality in a test animal population (rats, mice, guinea pigs).*

Source: Pesticides Division, Agriculture Canada.

Mammalian Toxicity Ratings

Insecticides

Ambush (permethrin)
Belmark (fenvalerate)
Birlane (chlorfenvinfos)
Cygon (dimethoate)
Cymbush (cypermethrin)
Dasanit (fensulfothion)
Decis (deltamethrin)
Diazinon (diazinon)
Dipel (Bacillus thuringiensis)
Di-Syston
Dyfonate (fonofos)
Furadan (carbofuran)
Guthion (Azinphos-methyl)
Lannate (methomyl)
Lorsban (chlorpyrifos)
Malathion (malathion)
Metaldehyde (metaldehyde)
Monitor (methamidophos)
Ripcord (cypermethrin)
Rotenone (rotenone)
Sevin (carbaryl)
Supracide (methidathion)
Thimet (phorate)
Thiodan (endosulfan)

Fungicides

Benlate 50W (benomyl)
Bravo 500 (chlorothalonil)
Bravo W75 (chlorothalonil)
Botran (dichloran)
Coppercide (copper hydroxide)
Fixed copper 50 W (coppre oxychloride)
Fixed copper 53 (copper oxychloride)
Copper oxychloride 50 (copper oxychloride)
Kocide 101 (metalic copper equivalent)
Copper 50W (copper)
Tribasic copper sulfate (copper sulfate)
Captan (captan)
Dithane M45 (mancozeb)
Manzate 200 (mancozeb)
Dithane M22 (maneb)
Manzate D (maneb)
Dyrene 50 WP (anilazine)
Easout (thiophanate-methyl)
Folpan 50WP (folpet)
Mertect (thiabendazole)
Phaltan 75WP (folpet)
Polyram 80W (metiram)
Polyram 7D (metiram)
Polyram DF (metiram)
Pro gro (carbathiin, thiram)
Rovral 50WP (iprodione)
Thiram (thiram)
Vitaflo 280 (carbathiin, thiram)
Zineb 80W (zineb)
Ziram 85W (ziram)

Herbicides

Afolan F, Lorox L (linuron)
AWK #1
Amitrol T (amitrol)
Bar Fox, Na ta, TCA (tricloroacetic acid)
Basfapon (dalapon)
Basagran (bentazon)
Buctril M (bromoxynil octanoate + MCPA ester)
Devrinol (napropamide)
2,4-D
Dual (methalochlor)
Dynap (napthalam + dinoseb)
Eptam (EPTC)
Excel
Eradicane (EPTC + R25788)
Fusilade (fluaziflop-butyl)
Goal (oxyflurofen)
Gramoxone (paraquat)
Hoe Grass 284 (diclofop methyl)
Karmex (diuron)
Kil-Mor (dicamba + 2,4-D + mecoprop)
Lexone (metribuzin)
Pardner (bromoxynil octanoate)
Poast (sethoxydim)
Prefar (bensulfide)
Primextra (metolachlor + atrazine)
Princep-Nine-T (simazine)
Rival, Treflan (trifluralin)
Ro-Neet (cycloate)
Roundup (glyphosate)
Sencor (metribuzin)
Sutan (butylate)

Protective Equipment for Pesticide Users

The use of protective equipment is an integral but often neglected facet of safety in the handling and application of pesticides. The wearing of a respirator, proper eye shields (goggles), gloves, footwear and other protective clothing is strongly recommended.

Chemical Cartridge Respirator

Dust masks are ineffective in protecting against pesticide vapours. Similarly, the filters on tractor cabs are intended to remove dust and are not designed to protect against pesticide vapours or mists. Chemical cartridge respirators are recommended for outdoor use when mixing and applying pesticides.

Only NIOSH-approved respirators should be used. Do not interchange component parts of respirators. For example, do not use a cartridge produced by company "A" with a respirator produced by company "B" as the combination may not provide adequate protection to the user.

When carrying out spray operations, filters should be changed each day, and the cartridges should be replaced when chemical odour becomes apparent or when breathing becomes difficult. New cartridges should always be installed at the start of the spraying season. Prior to commencing work, the face seal should be checked while the respirator is on the wearer's face. Regardless of design, respirators cannot be worn securely by people with beards, moustaches or sideburns.

Contact any of the supply companies listed below or the Department of Environment and Workplace Safety and Health for information on respiratory protection against specific pesticides.

Eye Protection

The use of protective goggles is necessary and recommended when a full face mask is not worn.

Many goggles are chemical resistant. Some have specially treated lenses to reduce fogging. Others have anti-fogging ventilation. Prescription type safety spectacles are also available. Side shields can be attached when necessary.

Gloves

Non-absorbent gloves should be worn at all times while handling, mixing and applying pesticides. Neoprene has been found superior to rubber in resisting the absorptive penetration of many substances associated with pesticides.

Other factors to be considered in selecting suitable gloves include sense of touch, wet grip, cut resistance and abrasion resistance. Gloves should fit snugly. Fabric wrist gloves should not be considered.

Footwear

Non-absorbent footwear should be worn when applying pesticides. The most suitable boot is one that is knee length, acid and solvent resistant, and cleated or ribbed to prevent slippage. Neoprene is considered superior to rubber in withstanding various acids and solvents.

Outer Clothing

A major concern in agricultural pesticide spraying is the unwillingness of the applicator to wear some form of protective clothing, particularly under warm summer conditions. **At the very least, coveralls should be worn along with gloves and a hat to minimize the hazard of dermally toxic (absorbed through skin) pesticides. The clothing should be changed and washed following spraying.**

Disposable garments suitable for pesticide work are now available. Made of "Tyvek" polyethylene fibers, such clothing will provide protection against dermal exposure resulting from pesticide drift, splashing or spills. Light-weight and economical, disposable garments are available as coveralls, shirts, pants, headcovers and aprons.

Supplies of goggles, prescription-type safety spectacles, neoprene gloves, boots and other protective clothing including hats, are available from any one of the major safety supply companies listed here.

Availability

Many pesticide dealers stock personal protective equipment for pesticide users. In addition, several Manitoba safety supply companies provide a wide range of products. Some firms offer complete lines, others specialize. The following companies can meet the needs of pesticide users:

- IPACO Safety Products - 775-8208 (Wpg.)
- Levitt - Safety Limited - 633-7228 (Wpg.)
- MSA Canada Incorporated - 632-7570 (Wpg.)
- Safety Centre Limited - 772-2495 (Wpg.)
- Safety Supply Canada - 453-7838 (Wpg.)

Check the Yellow Pages directory for addresses and branch locations.

In case of accident or poisoning with any pesticide, contact your local hospital. For further information, contact:

Poison Control
Health Sciences Centre
Children's Centre
685 Bannatyne Avenue
Winnipeg, Manitoba, R3E 0W1
Telephone: 1-787-2591

General Pesticide Recommendations

For proper pesticide use:

- Identify the pest problem.
- Use the recommended pesticide.
- Apply according to directions.

General Pesticide Guidelines

Know and observe the following guidelines:

- Never smoke while applying pesticides.
- Avoid inhaling sprays or dusts. Wear protective clothing and a respirator. Additional detail on personal protective equipment is provided here.
- Sprayer lines carrying pesticides must not enter the operator's cab.
- Have soap, water and a towel available. Should concentrated product spill on skin, hands, face or eyes, wash immediately.
- Wash hands and face when leaving the treated area, - before break periods, lunch, or for comfort.
- Bathe or shower and change to clean clothing after working with pesticides. Wash clothing each day before re-use.

- Call a physician or get the patient to a hospital immediately if symptoms of illness occur during or shortly after pesticide application. Be sure to take along the product label or container.
- Store pesticides out of the reach of children.
- Store pesticides where there is no chance of contact with human food or livestock feeds. Do not store herbicides with insecticides, and avoid cross-contamination. Storage areas should be locked.
- Keep chemicals in their original containers, never in unmarked containers or bottles used for food or drink.
- Never fill spray tanks directly from a drinkable water source such as a well or dugout.
- Follow proper container disposal methods. All containers should be triple rinsed or pressure rinsed, punctured to render the container non-reusable, and delivered to designated disposal sites.

Pesticide Container Disposal

Rinse all pesticide containers prior to disposal to reduce environmental contamination.

Triple Rinsing

Triple rinsing renders used pesticide containers (metal, plastic, glass) more than 99.9% free of residues in most cases.

Here are the steps that should be followed:

1. Empty contents of the container into the spray tank and drain in a vertical position for 30 seconds.
2. Add a measured amount of rinse water or other dilutent so container is about 1/5 full.
3. Rinse the container thoroughly and pour into the spray tank.
4. Repeat the procedure three times; it should only take about five minutes in total.
5. Triple rinsed containers should be punctured or broken to render them non-reusable. Paper bags should be rinsed once prior to disposal.

Pressure Rinsing

Pressure rinsers are also available. They have the versatility to rinse all sizes of empty pesticide containers that can be lifted into position over the spray tank.

Pressure rinsers are all constructed to be thrust into the bottom of a metal can or plastic jug. Holes, situated laterally in the rinser tip, direct water from a pressurized source onto the inner sides of the container and effectively wash the residual pesticide into the spray tank.

Some farmers have found it convenient to attach a rinser to the pump on their large water storage tank to minimize container handling.

A 30 second rinse with any of these pressure rinsers is convenient and just as effective as triple rinsing.

Pressure rinsers have the added advantage of rendering containers useless by automatically puncturing them.

Disposal of Containers

Properly rinsed containers should be delivered to a designated pesticide container disposal site. Contact your ag rep or weed supervisor for the locations of pesticide container disposal sites in your municipality.

Pesticide Spills

If a pesticide spill appears to be major (a hazard to property or environment), call:

Environmental Management Branch
Building 2, 139 Tuxedo Avenue
Winnipeg, Manitoba, R3N 0H6
Telephone: 945-4888 (24 hours)

Pesticide Drift

Pesticide drift can leave unwanted residues on adjacent crops, create a hazard to people and livestock nearby, and reduce the amount of material in the target area so that it is ineffective.

Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by:

- correct calibration and maintenance of spray equipment;
- correct operation of the equipment;
- being aware of the toxicity of the pesticide being used;
- being aware of the weather conditions.

Custom Application - Ground and Air

Custom applicators must be licensed by Manitoba Agriculture. For further information, contact Andy Kolach - 945-3859 (Wpg.).

It is an offense under the Federal Pest Control Products Act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees - e.g. Sevin (carbaryl).

Do not spray in winds above 15 km/h (nine mph). Within 1/2 hour of sunrise or sunset, do not spray in winds above 10 km/h (six mph).

Tank Mixes

A tank mix is when two separately purchased pesticides are mixed in the sprayer tank, as opposed to one preformulated mixture sold by the manufacturer. For specific details on tank mixing, refer to label recommendations provided by the manufacturers of the pesticides.

Tank mixes can include the use of two similar pesticides (such as herbicides) or two different pesticides (such as an insecticide combined with a fungicide). Several tank mixes of insecticides and fungicides are used by vegetable growers.

Use only tank mixes when registered and recommended as mixes. Use of unregistered tank mixes can result in crop injury or reduced pest control. When tank mixing, observe all precautions and restriction on both pesticide labels. Follow the longest time period for re-entry and harvest wait period.

Tank mixes of herbicides may result in crop injury and reduced weed control. When herbicides for grassy weed control are mixed with herbicides for broadleaf weeds, a partial loss of activity on wild oats is common. When reduced weed control is likely to occur, the advantages of tank mixing are soon lost.

The order in which the herbicides are added to the spray tank may be critical in avoiding physical incompatibility. When mixing herbicides to be applied in one operation, first mix one with the quantity of water to be used and agitate, before the second is added. To reduce the possibility of formation of precipitates or gums, which may clog nozzles or filters, add herbicides to the tank in the following order:

1. soluble powders
2. wettable powders and flowable liquids
3. solutions (amines and salts)
4. additives (surfactants)
5. emulsifiable concentrates

For specific mixing instructions, always check the label as there may be exceptions to the mixing order.

Caution: Use tank mixes only when registered and recommended for use.

Pesticide Formulation Abbreviations

E = Emulsion, emulsible
EC = emulsifiable concentrate
W = wettable
WP = wettable powder

Storage of Pesticides

- Keep pesticides out of reach of children, inexperienced persons, pets and livestock. Store them in a locked room away from your home. Post pesticide storage-area notices.
- Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers.

Herbicides

Herbicides which must be kept in heated storage (do not freeze):

- Agriculture Weedkiller No. 1
- Afolan F
- Amitrol-T
- Alanap 3
- Basagran
- Chloro-IPC (CIPC)
- Dyanap
- Dyvel
- Goal
- Gramoxone
- Hoe Grass 284
- Kil-Mor
- Lorox L
- Pardner
- Potato Top Killer 300
- Prefar
- Premerge 360
- Reglone
- Rival
- Ro-Neet 7.2E
- Simadex
- TCA Solution
- Treflan EC
- 2,4-D Amine

Herbicides which may be stored at freezing temperatures (these must be returned to their original state by warming to room temperature — 20 to 22°C — and agitating thoroughly before use):

- Aatrex Liquid
- Aatrex Plus
- Atrazine Liquid
- Buctril M
- Dual-Ciba-Geigy
- Eptam 8-E
- Eradicane 8-E
- Lexone L
- Primextra
- Roundup
- Sencor 500
- Sutan +
- Torch DS
- Triflurex

Trade Name	Chemical Name	Minimum Storage Temperature
Ambush	permethrin	-7° C
Cygon	dimethoate	+5° C
Diazinon	diazinon	-18° C
Malathion	malathion	-18° C
Dylox	trichlorfon	0° C
Furadan	carbofuran	0° C
Guthion	azinphos-methyl	0° C
Monitor	methamidophos	-9° C
Birlane	chlorfenvinphos	do not freeze
Belmark	fenvalerate	do not freeze
Supracide	methidathion	do not freeze
Cymbush	cypermethrin	do not freeze
Lorsban	chlorpyrifos	do not freeze (agitate well before use)
Decis	deltamethrin	do not freeze
Thiodan	endosulfan	do not freeze
Sevin	carbaryl	may be frozen (agitate well before use)
Lannate	methomyl	do not freeze

Herbicides normally sold as granules or powders: (these are not usually damaged by freezing; store in dry place)

- Aatrex WP
- Aatrex Nine-O
- Atrazine 80W
- Bar-fox
- Basfapon
- Bluestone
- Dowpon M
- Eptam 10G
- Lexone DF
- Na Ta TCA
- Princep-Nine-T
- Sencor 75 DF
- Simadex 80W
- TCA
- Treflan QR5

Field Application Hazard of Insecticides to Bees

Insecticide Trade Name	Chemical Name	Honey Bee	Leafcutter Bee	Residue Hazard (Days)
Ambush	permethrin	1	1	5
Belmark	fenvalerate	1	1	*
Birlane	chlorofenvinfos	3	*	*
Cygon	dimethoate	1	1	7
Cymbush	cypermethrin	1	*	*
Dasanit	fensulfothion	1	*	*
Decis	deltamethrin	1	1	1.5
Diazinon	diazinon	1	1	2
Dipel	Bacillus thuringiensis	3	3	none
Dyfonate	fonofos	2	*	*
Dylox	trichlorfon	2	2	0.5
Furadan	carbofuran F	1	1	5
Furadan	carbofuran G	3	3	none
Guthion	azinphos-methyl	1	1	5
Lannate	methomyl	1	1	1.5
Lindane	lindane	1	*	*
Lorsban	chlorpyrifos	1	1	3.5
Malathion	malathion	2	1	2
Methoxychlor	methoxychlor	2	2	0.5
Monitor	methamidophos	1	1	1
Pyrethrum	pyrethrum	3	*	none
Ripcord	cypermethrin	1	*	*
Rotenone	rotenone	3	*	none
Sevin	carbaryl	1	1	3-7
Thiodan	endosulfan	2	1	2

Legend

1. Very poisonous to bees; do not apply to crops or weeds in bloom unless bees are kept off for the period that residue on the crop is a hazard.
2. Moderately poisonous to bees; may be applied in the evening when bees are not foraging.
3. Not very poisonous to bees; may be applied wih minimum hazard to bees.

* Indicates no data available

Note: Most of the above chemicals have not been tested for bee toxicity under Western Canadian conditions; the data herein is for a general guideline only. Source: Atkins et al., Toxicity of Pesticides to Honey Bees, University of California, Co-op. Extension 170, 1974.

Residue hazard represents the average time in days that residue poisonous to bees will remain on the foliage.

Fungicides

Store liquids in a dry location at a temperature of 3 - 4°C. Store granules, powders, etc. in a dry location. Freezing temperatures are not detrimental to granular or powder formulations.

Insecticides

The following minimum storage temperatures are provided as guidelines for winter storage for liquid insecticides.

Insecticide Storage Temperatures

Trade Name	Chemical Name	Minimum Storage Temperature
Ambush	permethrin	-7° C
Cygon	dimethoate	+5°C
Diazinon	diazinon	-18°C
Malathion	malathion	-18°C
Dylox	trichlorfon	-0°C
Furadan	carbofuran	-0°C
Guthion	azinphos-methyl	-0°C
Monitor	methamidophos	-9°C
Birlane	chlorfenvinphos	do not freeze
Belmark	fenvalerate	do not freeze
Supracide	methidathion	do not freeze
Cymbush	cypermethrin	do not freeze
Lorsban	chlorpyrifos	do not freeze (agitate well before use)
Decis	deltamethrin	do not freeze
Thiodan	endosulfan	do not freeze
Sevin	carbaryl	may be frozen (agitate well before use)
Lannate	methomyl	do not freeze

Residue Tolerances and Days to Harvest

Tolerances for residues of agricultural chemicals on vegetables when offered for sale have been set by Health and Welfare Canada.

To avoid exceeding the residue tolerance for insecticides, herbicides and fungicides:

- **Do not apply them later than recommended.**
- **Do not apply them more often than recommended on the label.**
- **Do not apply more than the recommended amount.**

For further information contact:
Health and Welfare Canada
Food Directorate
Health Protection Building
Holland Avenue
Tunney's Pasture
Ottawa, Ontario
K1A 0L2

Information is also available from:
National Information Service
Pesticide Directorate
Agriculture Canada
1-800-267-6315

Insecticides and Pollinating Insects

Pollinating insects, especially honeybees and wild bees, are necessary for the production of some vegetable crops. It is therefore important for the grower to refrain as much as possible from poisoning bees foraging on these crops.

An insecticide application on any crop which is likely to poison neighborhood bees should be of concern to a vegetable grower.

The following points should be remembered when applying insecticides in the vicinity of pollinating insects.

- All insecticides are toxic to honeybees and other beneficial insects. Farmers, beekeepers, pesticide dealers and pesticide applicators must co-operate closely to minimize insect losses.
- Only the least toxic insecticides to bees should be used where honeybees or other pollinating insects may be foraging. Notify beekeepers in the area so they have an opportunity to protect their colonies.
- The application of insecticides during the early morning and late evening hours lessens the possibility of causing injury to honeybees and other pollinating insects.
- Do not apply insecticide on windy days, as drift toward any nearby beehives may cause poisoning.
- Ground applications are generally less hazardous than aircraft applications, and there is usually less drift.
- Where there is a choice, and bees will possibly be poisoned, choose the formulation less hazardous to bees. Dusts are more toxic than sprays. EC formulations are less toxic than WP formulations.

Insecticide Classification

Synthetic Pyrethroid	Organo-Phosphate	Organo-Chlorine	Carbamate	Biological	Botanical
■ Ambush (permethrin) ■ Belmark (fenvalerate) ■ Cymbush (cypermethrin) ■ Decis (deltamethrin) ■ Ripcord (Cypermethrin)	■ Guthion (azinphos-methyl) ■ Lorsban (chlorpyrifos) ■ Cygon (dimethoate) ■ Dasanit (fensulfothion) ■ Diazinon (diazinon) ■ Di-syston (disulfoton) ■ Dyfonate (fonofos) ■ Malathion (malathion) ■ Monitor (methamidophos) ■ Supracide (methidathion) ■ Thimet (phorate)	■ Thiodan (endosulfan)	■ Furadan (carbofuran) ■ Sevin (carbaryl) ■ Lannate (methomyl)	■ Thuricide (Bacillus-thuringiensis) ■ Dipel (Bacillus thuringiensis)	■ Rotenone (rotenone)

Insect Control

Slugs

For control on most vegetable crops, apply metaldehyde. Order ahead of time since companies do not generally stock supplies. Material should not be held over as it deteriorates quite rapidly.

Caution: Chemical should not be sprayed or sprinkled on vegetable crop foliage.

Cutworms

For control, apply the following chemicals according to label recommendations:

- Lorsban 4C or 4E or broccoli, brussel sprouts, cabbage, cauliflower, celery, cucumber, green peppers, bulb onions, potatoes, sweet corn and rutabagas.
- Ambush on asparagus, beets, carrots, cole crops, sweet corn, lettuce, onions, peppers and potatoes.

Onion Maggots

For control of onion maggots, apply Lorsban 15G as a furrow treatment with seed, according to label recommendations. Use only with dry seeded onions which are Pro-Gro treated.

Grasshoppers

Apply Malathion 50 EC at 0.689 L/acre.

Water pH and Insecticide Degradation

When certain insecticides are added to alkaline water (high pH), they begin to lose their effectiveness. The rate at which this degradation proceeds depends on several factors. These include: the pH of the water; the amount of insecticide being added; water temperature; the length of time the spray mix is allowed to stand.

In general, degradation affects pesticides classified as organo-phosphates and carbamates. Some pyrethroids are also known to be similarly affected.

An important fact to consider is that pesticide degradation (alkaline hydrolysis) in alkaline solutions is irreversible and initial effectiveness is lost.

The effect of alkalinity applies only while the mixture remains in the tank. The persistence of a pesticide is not affected by water pH after it is sprayed. It is very important, therefore, to spray the pesticide as soon as possible after mixing.

Herbicide and Liquid Fertilizer Compatibility

The mixing of herbicides in liquid fertilizer for application should be carried out only for products which are recommended for this use.

Thorough mixing and even application are required. Accurate calibration should be carried out to ensure the proper rate of herbicide application.

Compatibility of the herbicide in the liquid fertilizer should be tested before the herbicide is added to the tank. All registered products outline this procedure.

Re-entry to Treated Areas

Pesticide poisoning may occur where workers enter fields too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide fumes.

For some pesticides - e.g. parathion - the label carries a warning regarding working in treated crops from the time of application to the time of re-entry. Follow label recommendations at all times.

Where no label warnings are provided, the following minimum intervals are recommended:

- **24 hours** - Lannate, Supracide.
- **48 hours** - Birlane, Furadan, Guthion, Monitor

Effect of Rainfall on Herbicides

Rainfall shortly after application of a postemergence herbicide may reduce weed control. This table summarizes available information.

Product	Interval Required*
Buctril M	30 minutes
Torch DS	30 minutes
Pardner	30 minutes
Poast	1 hour
Hoe Grass 284	1 hour
TCA	1 hour
Fusilade	2 hours
Lexone	2 hours
Dalapon	4 hours
2,4-D Amine	4 hours
Banvel, Dyvel	4 hours
Roundup	6 hours
Sencor	6 hours
Kil-mor	6 hours
Basagran	8 hours
Amitrol-T	8 hours

Gramoxone- very rapidly absorbed by foliage. Very resistant to removal by rain.

**Time required between application and rainfall to avoid significant reduction inefficiency.*

The following vegetable crop herbicides can be applied with liquid fertilizer:

- Aatrex
- Primextra
- Dual-Ciba-Geigy
- Eptam
- Eradicane 8-E
- Ro-Neet 7.2E
- Rival
- Sutan (alone or with Aatrex)
- Treflan

Weed Control - Stale Seedbed

Crops

Beans (all types), beets, brussel sprouts, carrots, cabbage, cauliflower, corn, cucumbers, kale, onions, peas, potatoes, rutabagas.

Method

Prepare seedbed two to four weeks before seeding to stimulate weed growth. Seed without further cultivation and with minimum disturbance of the soil. Emerged weeds must be burned off with Gramoxone either before or shortly after seeding, but no later than three days before the crop will emerge.

Gramoxone (200 g/L)

Controls annual grasses and broadleaf weeds and top growth of perennial weeds. Apply 1.12 to 2.22 L/acre in 120 to 445 L/acre clean water pre-emergent to the crop, post-emergent to the weeds. Use the higher rate when weeds are above 5cm (2 in.) in height, and the higher volume of water on dense weed growth.

Herbicide Residues in Soil

Some herbicides recommended for crops leave a residue in the soil, affecting subsequent crops in the rotation. When growers rent land for vegetable and potato production, a detailed history of herbicide application rates and dates is strongly recommended.

The following table summarizes available information. Refer to product labels for specific information:

Product	Vegetable crops which may be affected the following year
Ally	**Caution:** *Ally residues may persist for two or more years at levels that may cause injury to horticultural crops. Ally is not recommended for use on a farm where horticulutural crops are included in the crop rotation, to avoid the risk of injury.*
Atrazine (includes all products containing atrazine)	• All crops except corn and triazine-tolerant canola. Flax, peas and faba beans have some tolerance to atrazine residues. If rate of application exceeds 0.446 kg/acre only corn or triazine-tolerant canola should be grown the following year. Atrazine residues may persist for more than one year.
Glean	**Caution:** *Glean residues may persist for two or more years at levels that may cause injury to horticultural crops. Glean is not recommended for use on a farm where horticultural crops are included in the crop rotation, to avoid the risk of injury.*
Karmex	• Do not replant treated areas to any crop within two years after last application, as injury to subsequent crops may result.
Lexone (preplant)	• All crops except potatoes.
Lontrel	• Due to limited availability of recropping data for horticulture crops, only wheat, barley, rye, oats, canola (rapeseed) or flax should be grown the year after application. Lontrel may persist for two or more years at levels that may cause injury to sensitive crops.
Primextra	• All crops except corn. Primextra contains atrazine. See comment for atrazine.
Princep Nine-T, Simadex, Simazine	• All crops except asparagus. Soil residues may persist for two or more years.
Rival, Treflan, Triflurex	Red beets, cucumbers, onions, parsnips and potatoes. Corn may also be sensitive to higher rates of application.
Sencor (preplant)	• All crops except potatoes.
Sinbar	• All crops except established alfalfa as recommended. Sinbar residues may persist for two or more years.
Tordon 202C	• Several broadleaf crops, including beans, peas, lentils and potatoes should not be planted until the fifth growing season after application. **Caution:** *Tordon 202C residues may persist for two or more years at levels that may cause injury to horticultural crops. Tordon 202C is not recommended for use on farms where horticultural crops are included in crop rotation, to avoid the risk of crop injury.*

Fertilizer

General Recommendations

Fertilizer Use

Most crops respond well to fertilizer when the available nutrient level of soil is low. Stubble fields are usually low in nitrogen and phosphorous. Fallow fields usually have adequate nitrogen but are low in phosphorous. Many fields may be low in sulphur and some may also be low in potassium. On the other hand, where high rates of fertilizer have been used for a number of years, the level of available nutrients may be adequate to meet crop requirements.

Soil Testing

To determine the specific nutrient content of individual fields, have your soil analyzed. Obtain details of sampling procedures from your agricultural representative's office or your fertilizer dealer. Cost of routine testing ranges from $10 to $20 plus Federal GST, depending on test required. Send your sample to:

Provincial Soil Testing Laboratory
Ellis Building
University of Manitoba
Winnipeg, Manitoba
R3T 2N2

For further details, see Manitoba Agriculture factsheets *Soil Testing Services in Manitoba* and *Soil Testing - 14 Common Questions.*

On the basis of soil test results, fertilizer recommendations are provided by the provincial lab. For all crops, a **standard soil test recommendation** is given, which suggests a single application rate for each nutrient required. These rates have been established to provide a good economic return from the fertilizer applied under reasonable Manitoba growing conditions.

For a number of common crops, **target yield fertilizer recommendations** are also provided, which give an indication of rates of fertilizer nutrients that would have to be applied to meet the requirements of the crop over a range of potential yields. With this information, producers have the flexibility of selecting a fertilizer application rate or target yield which best suits their individual situation.

Seed-Placed Fertilizer

The recommendations for maximum fertilizer rates which can safely be applied with the seed have been established for granular fertilizers, using double disc drill seeding equipment. This method places fertilizer close to the seed.

However, discers, hoedrills and air seeders vary in their ability to accurately place seed and fertilizer. Therefore, use discretion in increasing recommended maximum rates of fertilizer if the contact between fertilizer and seed is less than that obtained with a double disc drill.

The safe rate of fertilizer applied with the seed may also increase if fertilizer is applied in solution, rather than as granular fertilizer.

Major Nutrients For Annual Crop Production

Nitrogen

Nitrogen fertilizer is effective in increasing both yield and protein content. Its value in doing this is significantly affected by the time of application and method of placement. The various nitrogen carriers appear to be equally effective in increasing yields and/or protein content of annual crops when applied so that nitrogen losses are minimized. The greatest efficiency of all nitrogen fertilizers is obtained when the fertilizers are banded into the soil or applied in the seed row.

Urea and liquid or dry fertilizers containing urea should be well covered with soil to minimize losses. Apply anhydrous ammonia and aqueous ammonia at depths of 10 to 15 cm (4 to 6 in.) when soil conditions permit a good seal behind the applicator shanks. When crop is seeded less than five days after applying anhydrous ammonia and aqua ammonia, damage may occur specifically on sandy soil or under dry conditions.

The relative efficiency of nitrogen fertilizers is affected by time of application and method of placement. The average relative value of times and methods of application, when spring broadcast nitrogen is given a value of 100, can be calculated and are as follows:

Time and method	Relative Value
Spring broadcast	100
Spring banded	120
Fall broadcast	82
Fall banded	93

Note: *Broadcast values assume urea-based nitrogen carriers are incorporated where necessary to minimize losses incurred through ammonia volatilization, particularly on soils with a high pH or those which contain free lime in the surface soil.*

Banded values are based on any in-soil band application (including a with-the-seed band, as long as the rate applied does not exceed the safe limit where damage to germination or seedling emergence may occur). The band must not be disturbed prior to or during the seeding operation.

Losses of nitrogen due to leaching, gaseous loss, immobilization and weed growth are probably higher for fall-applied than for spring-applied nitrogen. This accounts for the differences in efficiencies between fall and spring indicated above.

These losses may be greater if the nitrogen is applied too early in the fall (prior to mid-September), or when soil temperatures at the 10 cm (4 in.) depth are greater than 5°C.

For further details see Manitoba Agriculture factsheet ***Nitrogen Fertilization in Crop Production****.*

Phosphorus

Most Manitoba soils are phosphorus deficient and give yield responses to fertilizer phosphorus application. The response to phosphorus by any crop is affected by factors such as:

- root development and distribution;
- ability of the plant to take up soil and fertilizer phosphorus;
- the method of phosphorus application;
- the soil available phosphorus level;
- soil type (soil texture, pH and carbonate content);
- soil water and temperature.

Ideally, plants need a good supply of phosphorus close to the seed during the first month of growth and an adequate quantity of phosphorus in the soil for the rest of the season.

Placing sufficient quantities of phosphorus with the seed, or close to the seed, have been the traditional methods for phosphorus application for annual crops in Manitoba. This satisfies early growth requirements and provides a reserve of phosphorus for the balance of the growing season.

Increasing the amount of phosphorus applied annually above that normally recommended (banded or broadcast) will increase the soil-available phosphorus. When high or very high levels are achieved, economic yields would be produced without addition of phosphorus fertilizer. However, the number of applications or years of phosphorus fertilization required to increase soil-available phosphorus to high or very high levels is unknown for most soils. Therefore, soil testing at regular intervals is a good way to monitor the nutrient level.

Caution: *High rates of applied fertilizer phosphorus (P_20_5) - annual rates in excess of 150 kg/ha (134 lb./acre) P_20_5 - may induce a micro-nutrient deficiency if soil levels of micronutrients (zinc, copper, etc.) are marginal.*

Banding With the Seed

Banding of fertilizer phosphorus with the seed results in the greatest yield increase per unit of phosphorus for all crops, providing the amount applied does not injure the germinating seedling. Crops such as cereals will tolerate all their fertilizer phosphorus requirements placed with the seed.

Banding Near the Seed

Banding fertilizer phosphorus near the seed (beside and/or below) results in the greatest yield increase per unit of phosphorus - when amounts in excess of those tolerated with the seed are required. Phosphorus placed in this manner is recommended for most oilseeds, annual legumes and row crops.

Deep-Banded

Deep-banded phosphorus placed at 10 to 15 cm (4 to 6 in.) soil depth and in spacings of 30 cm (12 in.) or less prior to seeding is more effective in increasing yields than phosphorus broadcast and incorporated. Nitrogen applied with the phosphorus will increase fertilizer phosphorus availability. Band these fertilizers together when both nitrogen and phosphorus are needed. Application of 10 to 15 kg/ha (9 to 13 L/acre) P_20_5 with or near the seed may also be required to ensure adequate supplies of phosphorus for early growth.

Note: *Take care not to disturb the bands during tillage and seeding operations.*

Surface Applied and Incorporated

Surface incorporation of fertilizer phosphorus results in the lowest yield increase per unit of phosphorus. The amount broadcast must be greater than the amount applied with or near the seed to obtain equal yield increases in the year of fertilizer application. Since the amount of broadcast phosphorus used during the first number of years has to be increased two to fourfold to equal yield increases from placement near the seed, broadcast application of phosphorus may be uneconomical on many soils.

Additional information is contained in the Manitoba Agriculture factsheets *Phosphorus Fertilization in Crop Production* and *Phosphorus Application for Annual Crops.*

Potassium

Most Manitoba soils contain sufficient available potassium for crop production. Those likely to contain insufficient potassium are the coarse textured (sands to sandy loams) and organic soils. Additional potassium may be required on about five to seven per cent of arable Manitoba soils for maximum production of the commonly grown annual crops such as cereals, rapeseed, and flax; on 25 to 40% of soils for the production of the special annual crops such as corn, potatoes, sugarbeets, and horticultural fruit or vegetable crops.

Potassium, where required, can increase crop yield and quality. Depending on the type of crop, it may increase frost and disease resistance, palatability, storability, etc. A soil test is recommended to determine whether a potassium application is warranted.

Within limits allowable for each crop, place potassium fertilizers in the seed row or side band whenever possible.

This provides the most efficient use of fertilizer by annual crops. The method and amount of potassium application are given under specific production recommendations for each crop.

The efficiency of broadcast potassium is one-half or less of that applied with the seed or side-band. If potassium is being broadcast, the rate recommended for seed placement or side banding should be doubled to obtain equal crop response. If broadcast, incorporate potassium fertilizer into the soil. Additional information is contained in the Manitoba Agriculture fact sheet Potassium Fertilization in Crop Production.

Sulphur

Sulphur deficiency may occur in many soils and in any area of the province. Therefore, a soil test is recommended to establish the available sulphur status of fields.

Sulphur levels can vary greatly from location to location within a field. As a result, attention should be given to the location where the samples are taken. On rolling ground, samples should be taken from a mid-slope area to give an idea of average field sulphur levels. On level land, samples should be taken from the best drained positions in the field. And adequate number of sites should be sampled in order to obtain a composite sample which is truly representative of the field.

Sulphur deficiencies are more likely to occur in crops having a high sulphur requirement, such as rutabagas. These crops also have a greater tendency to deplete the sulphur for subsequent crops. This is particularly true following breaking of a perennial forage stand.

Sulphur fertilizer recommendations are based on sulphur being applied in the sulphate ($S0_4$) form, since it is the only form readily available to plants.

Some nitrogen and phosphorus fertilizers contain sulphate sulphur; for example, 20-0-0 (24) 17-20-0 (15).

Since sulphate sulphur is usually applied in combination with nitrogen and phosphorus, it may be broadcast, banded or seed placed (as long as the safe limits for seed placed nitrogen and phosphate are not exceeded for the specific crops).

Ammonium thiosulphate, 12-0-0 (26), is a liquid formulation containing 26% sulphur by weight. One-half of the sulphur converts into the readily-available sulphate form and the remainder into finely divided elemental sulphur. This product can be applied at the rate recommended for sulphate sulphur.

Sulphur in the elemental form, as it occurs in some high-analysis sulphur products - such as flaked or prilled elemental sulphur (99% S), flowers of sulphur (99% S) or granular sulphur (99% S) - becomes available to plants when it oxidizes to the sulphate form. However, oxidation of sulphur requires time, and depends on soil temperature and moisture, size of sulphur granules and the rate at which granules break down in the soil. Research has found that sulphur from these products does not become available in sufficient quantities to meet crop requirements in the year of application. Therefore, they are not recommended for crops requiring applied sulphur to be available immediately. When elemental sulphur is used, it should be broadcast and incorporated well ahead of planting.

Micro-Nutrients

The majority of mineral soils in Manitoba contain sufficient micro-nutrients for most crops. Farmers should not apply micro-nutrient fertilizers unless they have established that deficiencies exist - through consultation with extension agronomists, a soil analysis, and/or tissue analysis.

The Provincial Soil Testing Laboratory offers a soil micronutrient analysis service. The cost for a copper-zinc-iron-manganese soil analysis is $10 per field plus Federal GST, if it is in addition to a routine soil test. These tests are performed only when specifically requested.

Additional information is contained in the Manitoba Agriculture factsheet *Micro-Nutrients in Crop Production.*

Plant Tissue Analysis

The provincial Soil Testing Laboratory offers a plant tissue analysis service, which measures the nutrient levels in growing crops. Test values are then compared to established values for inadequate, adequate and excess levels for each element and plant species. In this way, the nutritional health of the plant sample and the crop it represents can be assessed, and the supply and availability of nutrients to crops during the growing season can be evaluated.

Plant tissue analysis is useful in evaluating fertilizer management programs and practices, diagnosing nutrient related crop production problems, and identifying nutrient levels in crops that may limit top yield achievement. It is also especially useful in evaluating and identifying potential micronutrient problems.

Cost ranges from about $10 per sample (plus Federal GST) for a nitrogen-only analysis to about $20(plus Federal GST) for a complete 10-nutrient analysis.

Proper plant sampling and sample handling procedures are important. Detailed information on plant tissue analysis and complete instructions for sampling are contained in the Manitoba Agriculture factsheet *Plant Tissue Analysis.*

Organic Soils

Most organic soils are very deficient in phosphate and potassium. Farmers with organic soils should use the higher rates of phosphate and potassium recommended in this booklet for each crop.

Organic soils are also frequently deficient in copper, and may also be deficient in manganese and boron. Copper deficiencies are more likely to occur in organic soils (at least 60 cm or 24 in. in depth) and manganese deficiencies on the shallower organic soils (less than 36 cm or 14 in.) which are over a high-lime mineral sub-soil.

Use both soil and plant analyses as aids in determining if copper and manganese are lacking. Conduct small-scale trials (micro-nutrient applied to portions of a field) to assess the effects of micro-nutrient fertilizers on crop yields. Do this before micro-nutrients are used on large land areas.

Recommendations for micro-nutrient fertilizer use in these trials and in instances where deficiencies exist are outlined below.

Copper

Three different copper fertilizers are on the market. These are copper sulphate, sequestered copper and EDTA copper chelate. Copper sulphate is applied by broadcasting, but suquestered and EDTA chelate are handled much like herbicides. Producers interested in treating copper deficiency problems on organic soils may try the following:

- **Copper Sulphate** - Broadcast 44 kg/ha (40 lb./acre) of sulphate and incorporate. Fall application my be more effective than spring application. Applying copper sulphate at this rate may provide a residual effect for a number of years.
- **7.5% Copper EDTA Chelate** - Spray and incorporate 5.5 L/ha (2 quarts/acre) prior to seeding.
- **7.5% Copper EDTA Chelate** - If copper deficiency is noted very early in the growing season, producers may try 2.8 L/ha (1 quart/acre) EDTA as a foliar application in order to salvage the crop.
- **Sequestered Copper 5%** - Spray and incorporate 5.5 L/ha (2 quarts/acre) prior to seeding. Yields may be less than with EDTA.

Note: *When working with copper sulphate, safety precautions - such as wearing a dust mask and goggles, working upwind from the applicator, and washing hands before eating - should be observed. Because copper sulphate is very corrosive, equipment should be washed immediately after application.*

Additional information is available in the Manitoba Agriculture factsheets: *Introduction to Peat Soil Management*, *Crop Management on Peat Soils* and *Copper Requirements on Peat Soils*.

Manganese

10 to 15 kg/ha (9 to 13 lb./acre) manganese (for example 40 to 60 kg/ha, 36 to 54 lb./acre manganese sulphate) should be banded away from the seed of vegetable crops.

Boron

Incorporate 1 to 2 kg/ha (1 to 2 lb./acre) boron (for example, 9 to 17 kg/ha, 8 to 15 lb./acre borox) with the top 15 cm (6 in.) of soil.

Additional information is contained in the Manitoba Agriculture factsheet *Micro-nutrients in Crop Production.*

Calculation of Fertilizer Rates

Fertilizers are labelled by percentage according to thier guaranteed minimum analysis of nitrogen (N), phosphate (P_20_5) and potash (K_20). For example, 16-10-0 (14) contains 16% nitrogen by weight, 20% phosphate by weight, and 0% potash by weight - as well as approximately 14% sulphur by weight. The actual weight of nutrients in 100 kg (220 lb.) of this fertilizer would be: 16 kg (35 lb.) of nitrogen; 20 kg (44 lb.) of phosphate; no potash; 14 kg (31 lb.) approximately) of sulphur.

Examples1: Using 34-0-0

Rate of N desired: 45 kg/ha (40 lb./acre)

Rate of fertilizer required: $\frac{45 \times 100}{34}$ - 132 kg/ha

($\frac{40 \times 100}{34}$ = 117 lb./acre)

Example 2: Using 16-20-0 (14)

Rate of P_20_5 desired: 22 kg/ha (20 lb./acre)

Rate of fertilizer: $\frac{22 \times 100}{20}$ = 110 kg/ha

($\frac{20 \times 100}{20}$ = 100 lb./acre)

110 kg/ha (100 lb./acre) of 16-20-0 (14) would also supply nitrogen at the rate of:

$\frac{16 \times 110}{100}$ - 17.6 kg/ha ($\frac{16 \times 100}{100}$ = 16 lb./acre)

It would supply sulphur at the rate of:

$\frac{14 \times 110}{100}$ = 15.4 kg/ha ($\frac{14 \times 100}{100}$ - 14 lb./acre)

Additional information is contained in the Manitoba Agriculture factsheet *Calculating Nutrient Costs and Fertilizer Rates.*

Fertilizer Analysis

Liquids (solutions)

Ammonium phosphate	10-34-0
Nitrogen solution	28-0-0;32-0-0
Ammonium thiosulphate	12-0-0 (26)
Ammonium thiosulphate and nitrogen solution	15-0-0 (20)
Phosphoric acid	0-52-0
Gas (compressed)	
Anhydrous ammonia	82-0-0

Dry (solids)

Ammonium phosphate	10-50-0 to 11-55- 0
Ammonium phosphate sulphate	16-20-0 (14)
Urea ammonium phosphate	19-39-0
Diammonium phosphate	18-46-0
Ammonium nitrate phosphate	23-23-0; 23-24-0; 24-24-0; 25-25-0
Urea ammonium phosphate	27-27-0; 34-17-0
Ammonium nitrate phosphate sulphate	16-13-0 (13)
Ammonium nitrate phosphate	27-14-0;28-14-0
Ammonium sulphate	21-0-0 (24); 20-0-0 (24); 17-20-0 (15)
Ammonium nitrate	34.5-0-0
Urea-ammonium sulphate	34-0-0 (11)
Sulfur-coated urea	40-0-0 (6); 36-0-0 (20)
Urea	46-0-0
Mixed fertilizers	8-24-24 (3); 8-25-25; 10-30-10 (5); 10-34-10; 17-17-17
Potassium chloride	0-0-60; 0-0-62
Calcium sulphate (gypsum)	0-0-0 (13-19)
Sulphur (elemental)	0-0-0 (90)

Note: *The number in brackets denotes the approximate percentage of sulphur in the fertilizer.*

In addition to these pre-mixed fertilizers, micro-nutrients and blended fertilizers including suspensions are available from some fertilizer dealers.

Irrigation

Irrigation Management

Adequate irrigation produces top yields and top quality produce. Most crops give the best yields and make the most efficient use of water when soil moisture is near optimum level. The tubers and bulbs of some crops such as potatoes and onions will have a higher dry matter content when they receive optimum irrigation than when under-irrigated. Over irrigation will cause delayed growth and maturity, and in some cases may encourage the development of disease and lead to the development of soil salinity problems.

The amount and frequency of irrigation depends upon the kind of crop, the stage of development of the crop, the water holding capacity of soil, soil profile uniformity and the climate. The climatic factors include: temperature, sunlight, wind, rainfall and relative humidity.

Vegetable crops which have small seeds may require light and frequent water applications to enhance emergence of seedlings. This is particularly important where soil crusting is a problem. These light water applications should wet the top layer of the soil only (10 mm or 0.40 in. of water per application should be sufficient). If more water is applied it will increase crusting and will not keep the surface of the soil moist any longer than a light water application. Light water applications can be achieved successfully by using sprinkler irrigation systems. However, it is important to have sprinkler nozzles of proper size and maintain desirable operating pressure to avoid large droplets, which cause soil compaction. Irrigation at other than the hot period of the day will also help reduce crusting of the soil.

The available moisture for crop use varies with the soil texture.

Loamy sand - 8-12 mm moisture/0.1 m soil depth (0.9-1.4 in./ft)
Sandy loam - 10-15 mm moisture/0.1 m soil depth (1.2-1.8 in./ft)
Loam - 14-18 mm moisture/0.1 m soil depth (1.7-2.1 in./ft)
Sandy clay loam, clay loam, clay - 15-20 mm moisture/0.1 m soil depth (1.8-2.4 in./ft)
Silty clay loam, silt loam - 16-22 mm moisture/0.1 m soil depth (1.9-2.6 in./ft)
(mm = millimetre, m = metre)

The depth from which crops can effectively draw moisture varies with each crop. The allowable depletion (AD) of soil moisture varies with the crop and to a lesser extent the stage of crop development. Allowable depletion is a level of dryness that the plants can tolerate and still produce the desired yield. It is usually expressed as the per cent of available moisture in the root zone. (See the following table)

The recommended allowable depletion for vegetable crops is as little as 25% of available moisture and as much as 50%. The most critical period to avoid moisture stress is from flowering through seed formation, or during head, bulb or tuber development. The result of irrigating crops inadequately during the critical period is a lower yield and poorer quality produce.

The timing of irrigation and the amount of water to be applied depends upon both the crop rooting depth and the amount of moisture stress the crop can tolerate.

Example 1

A shallow rooted crop like onions can effectively draw moisture from 0.6 m (2 ft) depth of soil. However, yield is reduced if allowable depletion exceeds 35%. A loam soil holds 17mm/0.1 m (2in./ft.) of available moisture. This amounts to 102 mm (4 in.) in the root zone of 0.6 m (2 ft.)

Since the allowable depletion of available moisture is 35%, then removal of 36 mm (1.4 in.) of water is the maxiumum water depletion that can be tolerated. If mid-summer onions use about 5 mm (0.2 in.) per day, irrigation will be required every seventh or eighth day (assuming no rainfall occurred and normal crop growth and development is taking place). Soil moisture will be restored by applying 36 mm (1.4 in.) net of water. However, early in July onions use less than 4 mm (0.16 in.) per day and then irrigation is required every ninth or tenth day.

Example 2

Carrots have an effective rooting depth close to one metre (3 ft.) and have a higher soil moisture allowable depletion of 40%. If carrots are grown on a sandy loam soil which has a moisture holding capacity of about 10 mm/0.1 m (1.2 in./ft.) the root zone of 0.9 m (1 yd.) holds 90 mm (3.5in.) of available moisture. Since allowable depletion is 40%, 36 mm (1.4 in.)

can be depleted between irrigations without putting the crop under stress. At the beginning of July carrots use about 4 mm/day (0.16 in.) and toward the end of July this increases to about 6 mm (0.24 in.) per day. **Note:** *Some of the preceding material was taken from the 1983-84 Alberta Vegetable Production Guide, with permission.*

Financial Assistance

Two programs exist to provide financial assistance for the development of irrigation systems. A federal program, administered by the Prairie Farm Rehabilitation Administration provides 1/3 of eligible costs to a maximum of $2200 per system. PFRA offices are located in Brandon, Dauphin, Morden and Beausejour. The provincial program, administered by Soils and Crops Branch, Manitoba Agriculture,. rebates 30% of eligible costs to a maximum of $2000. For further information contact the Water Management Specialist, Soils and Crops Branch in Winnipeg, 945-1926.

Water Licensing

According to the Water Rights Act, pumping water for irrigation at more than 25,000 L (5,500 gal.) per day, regardless of the water source, requires a license. To apply for a Water Rights License, obtain an application form at any Water Resources, Agriculture or PFRA office in your area. For more information contact:

Manitoba Natural Resources / Water Resources
1577 Dublin Avenue
Winnipeg, Manitoba R3E 3J5
Phone: (204) 945-6699

Methods of Irrigation

Trickle Irrigation

Trickle irrigation of vegetables consists of supplying water to the vegetable rows in continuous wetted strips through the use of either porous tubing or multi-chambered tubing with closely spaced outlets.

Water is applied slowly and at low pressures, typically 34 to 100 kPa (5 to 15 psi). It is known that this method of irrigation requires less water than sprinkler irrigation, but commercial scale comparisons have not been made in Manitoba.

Filtration of water is an important consideration in the design of a trickle system. Filtration requirements depend on water quality and on the type of tubing used.

The cost of equipment is high and annual costs are especially high because the tubing has limited life when used on annual crops like vegetables.

Sprinkler Irrigation

Sprinklers have advantages, particularly to a vegetable grower, as they are adaptable to almost any soil or topographic condition, and can apply large or small amounts of water at one time. Sprinkler systems can also provide a light application to promote germination. However, the capital and operating costs of sprinkler systems are high.

Hand move systems using portable aluminum tubing are best suited to small acreages such as market gardens. They can be used for germination, if the pressures are high enough to provide a finer droplet size. If light water applications are desired, the lateral lines have to be moved often and this results in high labor requirements. In cases where the value of the crop warrants it, enough hand move laterals could be used to cover the entire field. This portable "solid set" system would be laid out in the spring and left until fall when it could be removed. Frost protection is also possible with a solid set system. The only labor involved during the growing season would be the opening and closing of valves and operating the pumps. The capital cost of the equipment would be very high red to a portable hand move system. On small acreages, the

Wheel roll systems are commonly used for vegetables in Manitoba. For vegetable crops, four 400 m (1/4 mile) laterals per quarter section can be justified by improved yield and quality, rather than the two laterals generally used with conventional field crops. Where surface crusting is a problem or when irrigation for germination is required, the nozzle size of the sprinklers could be reduced. This would result in an increased pressure and finer droplet size. Equipment costs vary depending primarily on the number of laterals that are required. Acreages smaller than a quarter section can also be irrigated with wheel roll systems, but the cost is higher and if the field is not rectangular in shape, the labor requirements are greater.

Volume guns consist of one large sprinkler which may discharge between 100 and 500 US gallons/minute (380 and 1900 L/minute). These sprinklers can be set up and allowed to operate in one spot and then moved to a new location or else they may be self-propelled. These are known as travelling volume guns. Volume guns require a high operating pressure and therefore have high energy costs, but are very adaptable to odd shaped fields and to tall crops, even for tree nurseries. The spray pattern of these guns is severely affected by wind.

Centre pivot systems are also suited to vegetable crops, provided a large area free of obstruction is available. Some operators have a quarter section pivot, of which one-half or one-quarter of the circle is in vegetable crops. Shorter centre pivot machines are available, and although the per acre cost is high, they may be a viable alternative for vegetable crops. Major advantages of pivots are that they require a relatively small amount of labor, have the ability to operate on rough topography and have variable speed which permits light applications

Lateral move systems are similar to centre pivots in that they move continuously while irrigating. However, instead of rotating around a centre point, this type of system moves sideways, sweeping a rectangular area. Water is usually supplied through a flexible hose similar to those of travelling guns. Automation, low energy requirements and uniform water application with a high degree of control are the main advantages. High capital cost is the main disadvantage.

Polyethylene Films

The production of heat-loving crops can be improved by employing polyethylene (plastic) films. Crops which respond to plastic films include cucumbers, peppers, watermelon and muskmelons.

Techniques

Those recommended for commercial production in southern Manitoba include:

- **Plastic Mulch**
  The plastic film is available in clear or opaque stock of varying widths and thicknesses which can be laid over a well prepared seedbed prior to planting. **Clear** plastic, 1.5 mil thickness and 1.2 m (4 ft.) width, appears to be best suited to vegetable production in Manitoba.
- **Plastic Mini-tunnels**
  These are installed after planting and consist of clear-ventilated or shaded (white) films stretched over wire hoops in a semi-circular design. The plastic used is 2.0 mil thickness and 1.5 m (5 ft.) in width. Use No. 9 gauge galvanized wire in lengths of 1 m (3 ft.). Tunnel dimensions are 45 to 60 cm (18-24 in.) at the base and 45 cm (18 in.) in height.

  Clear plastic will require ventilation. Ventilated plastic is commercially available. However, after installation, the mini-tunnel non-ventilated plastic can be ventilated by cleanly punching or burning (use butane torch) 2.0 - 2.5 cm (3/4 to 1 in.) holes spaced 20 - 30 cm (8 to 12 in.) along the top and sides of the tunnel.

Soil Moisture

Moisture availability must be ample prior to the installation of plastic films. If required, thoroughly irrigate the field a few days prior to laying plastic mulch or mini tunnels.

Seeding/Planting

Transplanting or seeding precedes the installation of mini-tunnels. Therefore, conventional seeders or transplanters can be used. Similarly, seeding operations will precede the laying of plastic mulch. However, a transplanted crop requires the placement of the plants through the plastic mulch. Specialized "mulch planters" are available and will accurately place transplants through plastic mulch.

Installation

The laying of plastic mulch has been mechanized and once installed, remains so for the entire season.

Mini-tunnel installation has been partially mechanized. The plastic film is mechanically stretched over the supporting wire hoops which are manually placed 1.8 to 2.4 m (6-8 ft.) apart along the row. A week prior to removal, mini-tunnels are slowly opened, and are totally removed approximately four weeks after installation.

Both techniques require that the applicators securely anchor the polyethylene edges (at least 15 cm (6 in.) on each side) in a furrow with soil.

Removal

Plastic mulch diggers and retrievers are commercially available. These units range in function from lifting the poly film and laying it loosely back on the ground for pickup and disposal, to baling it for immediate disposal.

For mini-tunnel removal, Manitoba Agriculture has adapted a variable speed hydraulic spool which efficiently lifts and bales the plastic.

Advantages

- **Yield**
  Depending on crop and variety, increases in yield as high as 75 - 90% have been recorded on heat-loving crops within Manitoba.
- **Maturity**
  Clear plastic mulch has shortened the time to crop maturity by as much as 7 days.
- **Soil Temperature and Moisture**
  Plastic mini-tunnels and mulch can increase temperature by as much as 5 to 6°C, while conserving and maintaining uniform levels of soil moisture. Higher spring soil temperatures and reduced leaching improves the availability of soluble nutrients which results in quicker plant establishment and enhanced crop vigor.

Other Considerations

- Black or opaque polyethylene films are not recommended for vegetable production in Manitoba. The use of clear or shaded (white) plastic will allow weed growth requiring the use of a recommended herbicide.
- Plastic mini-tunnels provide very little frost protection. Planting earlier than recommended for your area should be avoided.
- Photo-degradable films have not performed satisfactorily in tests conducted by Manitoba Agriculture.
- Commercial use of polyethylene film techniques will substantially increase production costs and may require changes involving machinery, plant populations, fertility, etc.
- Investigate thoroughly the use of polyethylene films before proceeding extensively with the technique. For more information contact:
  Manitoba Agriculture
  Vegetable Crop Specialist
  25 Tupper Street North
  Portage la Prairie, Manitoba R1N 3K1
  Phone 239-3359

Irrigation Requirements of Vegetables

Crop	Rooting Depth - metres (ft)	Allowable Depletion of Available Moisture - (%)*	Comments
Beans (fresh market)	0.9 (3 ft)	40	Beans are sensitive to moisture stress during the period of flowering to seed formation. A waterlogged soil during flowering or pod formation stages will reduce seed yields and encourage the development of diseases.
Beans (dry beans)	0.9 (3 ft)	50	
Beets	0.9 (3 ft)	50	
Broccoli	0.6 (2 ft)	40	Broccoli and cabbage are most sensitive to moisture stress at the time of head formation and enlargement.
Carrots	0.9 (3 ft)	40	Several small applications of water near the time of emergence will aid in obtaining a uniform stand. Carrots are sensitive to moisture stress during the root enlargement period. In fall, an excessively wet soil will encourage the development of soft rots.
Corn (sweet)	1.0 (3.2 ft)	40	Corn is sensitive to moisture stress from tassel to seed formation stages.
Cucumbers	0.6 (2 ft)	50	Available soil moisture should be kept above 60% after flowering begins.
Lettuce	0.6 (2 ft)	25	Lettuce is sensitive tc moisture during head formation. Excessive moisture in the seedling stage may cause seedlings to die off.
Onions	0.6 (2 ft)	35	Light irrigation may be needed early in the spring to aid the emergence of onions. Moisture stress during the bulb formation period will reduce the yield and the dry matter content. Do not water after the third week of August to allow time for ripening of bulbs.
Parsnips	1.0 (3.2 ft)	40	
Peas	0.6 (2 ft)	30	Peas are most sensitive to moisture stress from the beginning of flowering through pod formation. Peas are sensitive to waterlogged soil.
Peppers	0.9 (3 ft)	30	Moisture stress during flowering and fruit development will reduce yields of peppers.
Potatoes	0.8 (2.5 ft)	30	Potatoes are sensitive to moisture stress from tuber formation until ripening of the vines begins. If the soil is kept moist at the time of tuber formation, this increases the number of tubers formed but reduces the average size of tubers. Late potatoes which do not suffer moisture stress will have a higher dry matter content than potatoes which have been stressed during the growing period. Potatoes grown for commercial purposes have a slightly higher allowable depletion level.
Tomatoes	0.9 (3 ft)	40	Tomatoes are sensitive to moisture stress from the time of flowering through to full enlargement of the fruit.

* A crop that has an allowable depletion of 25% of the available moisture will require irrigation twice as often as a crop that has an allowable depletion of 50% if they have the same depth of rooting and daily water use. Available moisture is the moisture that is held in the root zone between field capacity and wilting point.

Production Recommendations

***Note:** Pesticides in this section are recommended on the basis of safety, effectiveness and availability. Those **not** listed may be used in Manitoba if they are registered under the Canada Pest Control Products Act, and have a permit as outlined under the Clean Environment Act.*

No endorsement of named products is intended, nor is criticism implied of similar products not included.

Rates of application for insecticides, herbicides and fungicides are stated as actual amounts of product required per acre unless otherwise indicated.

Asparagus

Varieties

Mary Washington, Jersey Giant.

Seedling Production

Plant seed 2.5 to 3.8 cm (1 to 1 1/2 in.) deep, and 9 to 10 cm (3 to 4 in.) apart in rows 45 to 60 cm (18 to 24 in.) apart. 1.1 kg/ha (1 lb.) of seed should be sufficient to provide crowns for one acre. Use only strong, vigorous one-year-old roots (crowns) for transplanting.

Transplanting and Spacing

In the early spring following seeding, dig the year-old plants and select those which have at least 10 roots. Choose fertile land that is well drained. For transplanting, open a furrow 15 to 20 cm (6 to 8 in.) deep. Space plants 30 to 45 cm (12 to 18 in.) apart in rows 120 to 150 cm (4 to 5 ft.) apart. Spread the roots and cover with 5 cm (2 in.) of soil and firm well. Fill the furrow gradually by cultivating as the plants grow, until the furrows have been filled level with the field.

Fertilizer

Pre-Planting of Crowns

Broadcast and incorporate 20 to 60 kg/ha (18 to 54 lb./acre) nitrogen, and 120 to 160 kg/ha (107 to 143 lb./acre) phosphorus (P_20_5) and 125 to 175 kg/ha (112 to 156 lb./acre) potash (K_20). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. 30 kg/ha (27 lb./acre) **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 14.

Established Beds

Apply annually, immediately after final harvest, 60 to 100 kg/ha (54 to 89 lb./acre)N, and 120 to 160 kg/ha (107 to 143 lb./acre) P_20_5. Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast 250 to 300 kg/ha (223 to 266 lb./acre) of potash (K_20). 30 kg/ha (27 lb./acre) sulphate sulphur (S) is recommended on well drained soils. For information of the application of different forms of sulphur fertilizer, see page 14.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Established stands only. Before spear emergence or after last cutting.

Afolan F (480g/L), Linuron 400L(400g/L),Lorox L (480 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. Apply Afolan F at 1.42 to 1.9 L/acre in 90 to 135 L/acre water or Linuron 400 L at 1.72 to 2.23 L/acre in 80 to 160 L/acre water or Lorox L at 1.82 L/acre in 120 L/acre water or apply Lorox DF at 1.34 kg/acre to 1.74 kg/acre in 120 L/acre water. Treatment may be repeated after last cutting. Do not use on sandy or coarse textured soils low in organic matter (less than 3%). Do not replant to other crops within four months after application.

Gramoxone (200 g/L)

Controls annual grasses, broadleaf weeds and top growth of perennial weeds. Apply 1.11 to 2.22 L/acre in 120 to 445 L/acre clean water to emerged weeds. Use the higher rate when weeds are above 5 cm (2 in.) in height, and the higher volume of water on dense weed growth. Do not apply to emerged spears which are to be used for human consumption.

Karmex (80%)

Controls several grass and broadleaf weeds. (Table •) Apply as a band or broadcast treatment. On light sandy soils or other soils low in clay or organic matter apply Karmex at 0.44 to 0.91 kg/acre product in 100 to 160 L/acre water. On soils high in clay or organic matter, use 0.91 to 1.82 kg/acre product in 100 to 160 L/acre water.

Two applications may be used: the first application should be made before weeds become established, but no earlier than four weeks before spear emergence and no later than early cutting period (if weeds are controlled into the cutting period by cultural practices, application may be delayed until immediately after the last cultivation). A second application may be made immediately following completion of harvest provided rainfall is expected. When two applications are used in one season, do not exceed 1.31 kg/acre per application. If irrigation is used, apply only a single treatment of 1.82 kg/acre in late September or October.

Well established weeds should be eliminated by mechanical or other means. For best results, the soil should be well prepared and as free as possible from trash and clods. Sufficient moisture in the form of rainfall or irrigation is necessary after treatment to carry the chemical into the root zone of germinating weeds.

Note: Spray booms must be shut off while starting, turning, slowing or stopping or crop injury will occur. The soil surface should not be cultivated or disturbed after application as weed control may be reduced and/or crop injury may result. ***Do not replant treated areas to any crop within two years after last application as injury to subsequent crops may result.*** *Do not use on soils with less than one per cent organic matter content.*

Lorox L

See Afolan F.

Princep Nine-T (90%), Simadex 80W (80%), Simazine 80W (80%)

Controls barnyard grass, wild oats and several broadleaf weeds. Apply Princep Nine-T at 1.01 to 1.52 kg/acre or Simadex 80W or Simazine 80W at 1.11 to 1.72 kg/acre product in 120 L/acre water after discing in spring prior to weed and spear emergence and at least seven days before first cutting. A second application may be made after harvest completion if weeds are removed. Do not apply during cutting season.

Caution: *Simadex 80W, Simazine 80W and Princep Nine-T are residual herbicides. Do not plant any crop in the treated area in the same year except corn.* ***Do not exceed recommended rate*** *or overlap as injury may result to succeeding crops. Extended periods of dry weather during the year of treatment will cause increased carryover which can cause injury to succeeding crops such as white beans, onions, peas, tomatoes and turnips.*

Rival (500 g/L), Treflan EC (545 g/L)

Use only on asparagus that has been established three seasons or more. Controls green and yellow foxtail and several broadleaf weeds. Trifluralin-resistant green foxtail has developed in Manitoba. Rival and Treflan will not control trifluralin-resistant foxtail. Refer to "Resistance of Weeds to Herbicides"in the current Guide to Chemical Weed Control for details. Apply in the spring after ferns are removed but before spear emergence; or after harvest in late spring or early summer before ferning begins.

Soil Type

Product	Light Soils with 2-6% organic matter	Medium to heavy Soils 6-15% organic matter
Rival	0.81 L/acre	1.21 - 1.62 L/acre
Treflan EC	0.73 L/acre	1.09 - 1.50 L/acre

Where a rate range is indicated use the higher rate for season long control. Apply in 45 L/acre water. Follow recommended soil preparation application and incorporation procedures in the Herbicide Incorporation section of the current Guide to Chemical Weed Control. Implements must be set so asparagus crowns are not injured during soil preparation and incorporation.

Sencor 500F (500 g/L/acre), Sencor 75 DF (75%)

Use only on established asparagus. Controls several broadleaf weeds. Apply 0.91 to 1.82 L/acre Sencor 500F or 0.61 to 1.21 kg/acre Sencor 75 DF in 45 to 120 L/acre as a pre-emergence broadcast spray. Apply in early spring before asparagus spears or ferns emerge and/or following the last cutting. If the field is to be disked apply the Sencor after disking but before the crop emerges. Do not apply within four days of harvest. Leave a minimum of five days between application of Sencor and other herbicides. Do not use on newly seeded asparagus nor on young plants during the first growing season after setting crowns. Do not apply to established crops after emergence of spears.

Irrigation

Apply 2.5 cm (1 in.) water every 10 days during harvest if an equal amount of rain is not received. To develop healthy, vigorous roots for the following year's crop, apply 5 cm (2 in.) water after harvest and 2.5 cm (1 in.) water toward the end of the growing season.

Disposal of Fern

Retain asparagus fern all winter to trap snow. This protects the crowns from low temperature winter injury. In the spring, chop the fern with a rotary or flail-type mower before a light discing. Use a minimum of cultivation for fern disposal and weed control.

Harvest and Storage

Asparagus may be harvested on a limited scale in the third year following seeding or in the second year after planting one-year-old crowns. The number of cuttings can be gradually increased and extended to the later part of June by the fourth year. The spears should be cut 12 mm (1/2 in.) below the soil with a sharp knife when they are 12 to 20 cm (5 to 8 in.) long.

Freshly harvested asparagus is very perishable and loses quality rapidly. Collect harvested spears as soon as possible, protecting them from the sun, and move to cold storage or market as soon as possible. If short term storage is necessary, store under high humidity (95%) at 1° to 2°C.

In Manitoba, a well tended asparagus bed can remain productive in excess of 15 years.

Disease Control

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments
Rust or Ployram	Polyram 80W or Polyram DF	0.911 - 1.315 kg	If rust was severe in the previous year, apply to fern growth 10-14 days after last cut followed by applications every two weeks until late summer. Do no apply to spears that are to be harvested. Established Mary Washington plantings are resistant to rust.
	Zineb 80W	0.445 - 1.335 kg	Apply at 5-10 day intervals. Do not apply to spears to be cut.
Crown rot, Seedling blight Do not plant into heavily infested soils or cultivate deeper than 10 cm (4 in.).		Rate=2g product /L of water	Dip 3,000 crowns in 100 L of solution for 15 to 20 minutes before planting.
Fusarium			To reduce losses avoid practices which stress the plants including poor fertility, over harvesting and deep cultivation.

Beans (Snap)

Varieties

Green Podded

Tendercrop; Bush Blue Lake; Provider; Green Pak.

Wax Podded

Kinghorn; Gold Rush; Round Pod Kidney Wax; Top Notch Golden Wax.

Seed Treatment

Treat seed with captan, thiram or Vitaflo 280 for protection against seed maggots and seed borne diseases. Ready prepared seed dressings are available from the trade, and should be used according to manufacturer's directions.

Seeding

Place seeds about 3.8 to 5 cm (1 1/2 to 2 in.) deep. Space rows 60 to 96 cm (24 to 38 in.) apart, according equipment available. Populations of 20 to 26 plants/m (six to eight plants/ft) in the row are desirable. Use 67 to 90 kg/ha (60 to 80 lb./acre) seed. Beans germinate best between 15° to 29°C.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.) See Tables at the back of this book for individual recommendations based on a soil test analysis.

Beans are legumes and thus can have an association with nitrogen fixing bacteria, which convert nitrogen from the soil air into a form the bean plant can use. These bacteria are available from garden centres and seed companies as pea and bean inoculants. If an area has never grown beans or peas before, additions of inoculants are recommended. Heavy applications of manure or fertilizers high in nitrogen may induce a large amount of vine or leaf growth, and frequently delay pod maturity and reduce yield.

As a general application, broadcast and incorporate 20 to 60 kg/ha (18 to 54 lb/acre) of nitrogen, and 120 to 160 kg/ha (107 to 143 lb./acre) of phosphate (P_20_5). The amount of nitrogen required will be less in soils where beans have been grown before and where there are sufficient soil organisms established to fix nitrogen in the soil. Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 35 to 70 kg/ha (31 to 62 lb./acre) of potash (K_20). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half on well drained soils, an application of 30 kg/ha (27 lb./acre) sulphate sulphur(S) fertilizer is recommended. For information on the application of different forms of sulphate sulphur fertilizer, see page 14.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Irrigation

Moisture requirements are most critical from the bud stage to harvest. The crop requires 2.5 to 3.8 cm (1 to 1 1/2 in.) moisture/week during this period for maximum yields.

Weed Control

Stale Seedbed

See the Stale Seedbed Weed Control section at beginning of Horticulture Section.

Preplant Incorporated

Eptam 8-E (800 g/L), Eptam 10G (10%)

Snap beans only. Controls annual grasses and several broadleaf weeds (Table 1). Spring application only. Apply 1.71 to 2.22 L/acre in at least 45 L/acre water. Eptam must be applied to a dry soil surface of a well prepared seedbed. Incorporate immediately according to label or current *Guide to Chemical Weed Control.*

Rival (500 g/L), Treflan EC (545 g/L)

Snap beans only. Spring application only. Controls green and yellow foxtail and several broadleaf weeds. Trifluralin-resistant green foxtail has developed in Manitoba. Rival and Treflan will not control trifluralin-resistant foxtail. Refer to "Resistance of Weeds to Herbicides" in the current Guide to Chemical Weed Control for further information. For snap beans apply 0.65 to 1.13 L/acre of Rival or 0.61 to 0.81 L/acre of Treflan EC as a spring preplant application in at least 45 L/acre water. See the Herbicide Incorporation section in the current Guide to Chemical Weed Control for application and incorporation instructions. Rival and Treflan leave a residue in the soil which may affect subsequent crops.

See Table 24 in the *Guide to Chemical Weed Control* for a list of susceptible crops.

Postemergence

Basagran (480 g/L)Controls several annual broadleaf weeds. (Table 1) Apply 0.7 to 0.91 L/acre in 80 to 160 L/acre water after first trifoliate leaf stage. Add Assist Oil Concentrate at 0.81 L/acre. Reduce to 0.405 L/acre Assist Oil Concentrate under hot humid conditions.

Suppresses Canada thistle and field bindweed with split application of 0.71 L/acre plus 0.71 L/acre applied seven to 15 days later in 80 to 160 L/acre water. Add Assist Oil Concentrate at 0.81 L/acre. Reduce to 0.405 L/acre Assist Oil Concentrate under hot humid conditions. Apply when thistles are 15 to 20 cm (6-8 in.) tall. Apply when field bindweed has developed a dark green colour and before it has begun trailing.

Cool weather or drought will delay herbicidal activity and if prolonged, may result in poor weed control. Use of Basagran in hot, humid weather may result in temporary leaf yellowing, leaf flecking, bronzing or burning.

Hoe-Grass 284 (284 g/L)

Snap beans only. Controls wild oats, green and yellow foxtail, barnyard grass. Apply 1.42 L/acre in at least 45 L/acre water at a nozzle pressure of 40 psi (275 kPa). Direct nozzles 45° forward. Apply when the weeds are in the one to four leaf stage and before they tiller. Other post-emergence herbicides must be applied at least four days after Hoe-Grass applications. Do not apply if rain is expect within an hour. Do not apply within 60 days of harvest. Application under hot (above 27°C) or drought conditions will reduce control.

Weed Resistance Note: *Hoegrass 284-resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Poast (184 g/L) Controls several grassy weeds

Weed	Rate (L/acre) with Assist	Rate (L/acre) With Merge
green or yellow foxtail barnyard grass, proso millet, witch grass & volunteer corn	0.324-0.405	0.324-0.405
wild oats	0.57 - 0.65	0.57 - 0.65
volunteer wheat & oats	0.65	0.57 - 0.65
volunteer barley	0.65 - 0.77	0.57 - 0.65
quackgrass suppression	1.78	1.10

Where a rate range is specified for a weed, use the higher rate to control heavy infestations.

Apply Poast with Assist Oil Concentrate or Merge at 1 L/100 L spray solution. The use of Merge will provide more consistent annual grass control than Assist. Apply with stainless steel 80° flat fan nozzles and use 40 to 45 psi (275 to 300 kPai) pressure. Use 25 to 45 L/acre of water. If weed infestation or crop canopy is dense, use 80L/acre water and apply at 300 kPa (45 psi) nozzle pressure. Apply when the majority of grassy weeds are in the two to five leaf stage. Control may be reduced if grasses are not actively growing due to drought, flooding or prolonged cool periods (15°C or less). Do not use flood jet or hollow cone nozzles. For quackgrass suppression ensure that quackgrass rhizomes are thoroughly fragmented by spring tillage prior to seeding. Apply Poast at the one to three leaf stage of the weed in 45 to 60 L/acre of water with Assist Oil Concentrate or Merge at 2 L/100 L spray solution. Control will be enhanced by inter-row cultivation but do not cultivate sooner than 7 days after application.

For aerial recommendations see the Aerial Application section in the current Guide to Chemical Weed Control. Apply no later than 60 days prior to harvest for snap beans and no later than 80 days prior to harvest for lima beans.

Allow four days between application of Poast and any other chemicals. Do not seed cereals, forage grasses, corn or other sensitive crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to re-seeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information. Poast & Power Pak*

Snap beans only. Controls volunteer cereals at reduced rates of Poast as well as annual grasses including green and yellow foxtail, barnyard grass and wild oats. Apply 0.57 L/acre Poast with 1.62 L/acre Ammonium Sulphate and add Assist Oil Concentrate at 1 L/100 spray solution. Apply when the majority of grassy weeds are in the two to five leaf stage with 24 to 45 L/acre of water. For heavy infestations or if the crop canopy is heavy, use Assist Oil Concentrate at 1 L/100 L spay solution in 80 L/acre of water. To mix, partially fill the tank with water while the agitation runs. Add Ammonium Sulphate to the tank first, then add the correct amount of Poast. Lastly, add Assist Oil Concentrate and continue filling with water. Use 80° flat fan nozzle and 275 to 300 kPa (40 to 45 psi) pressures. Do not use flood jet or hollow cone nozzles. Allow at least four days between application of Poast and application of broadleaf weed herbicides. Control may be reduced if grasses are under stress due to prolonged cool weather (15°C or less), drought or flooding. Apply no later than 60 days prior to harvest. Do not seed cereals, forage grasses, corn or other sensitive crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required seven days prior to re-seeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields, in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" in the current Guide to Chemical Weed Control for further information.*

Caution: *Ammonium Sulphate is corrosive to metal. Thoroughly clean the sprayer after using Ammonium Sulphate. Do not let mixtures stand in the tank for lengthy periods.*

Disease Control

Crop Rotation Note: *Allow three years between bean crops. Avoid other susceptible crops such as carrots, lettuce, parsnips, cucurbits, cole crops and sunflowers. Rotate with non-susceptible crops such as beets, onions, corn and cereals.*

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Anthracnose (use only disease free seed, practice a 3-year rotation, do not work in crop when wet).	Copper 50 W	2.226 kg	Apply at first sign of disease	1
	Tri-Basic Copper Sulfate	2.428 kg	Apply at first sign of disease	1
	Zineb 80W	0.445-1.335 kg	Apply at 4-7 day intervals	7
Bacterial Blight (use only disease-free seed, practie a 3-year rotation, do not work in crop when wet).	Copper 50W	2.226 kg	Apply at first sign of disease	1
	Kocide101	1.376		1
	Coppercide	0.910-1.315 kg		1
	Tri-Basic Copper Sulfate	2.428		1
Seed Decay (Damp of)			Treat seed with captan, thiram or Vitaflo 280	
Shite mold (Sclerotinia)	Benlate	0.708-0.911 kg	Apply between 50% and fullbloom with enough water to obtain full coverage. Under severe conditions use high rate.	14
	Botran 75W	1.315 kg		2
	Rovral 50WP	0.607 kg		14
Fusarium & Other Soil-borne Root Rots			Treat seed with captan thiram or Vitaflo 280 seed protectants. Avoid poorly drained soils.	

Beets (Red)

Varieties

Round

Early Wonder (bunching); King Red; Ruby Queen; Detroit Dark Red; Vermilion.

Cylindrical

Formanova.

Seed Treatment

Seed should be treated with thiram or captan before seeding. Apply according to manufacturer's directions.

Transplants

For early beets, sow seed in greenhouse six weeks prior to planting in the field. Seedlings should be placed approximately 7.6 cm (3 in.) apart in rows 30 to 40 cm (12 to 16 in.) apart when transplanted in the field. Care should be taken not to break the tap root.

Seeding

Sowing at two week intervals will provide a continuous supply for summer markets. Beets for storage should be sown about 10 weeks before normal harvest date.

Optimum germination temperature is 4° to 29°C. Seed should be placed 1 to 2 cm (1/2 to 3/4 in.) deep. About 3 kg (6 lb.) seed will plant an acre when seeded in rows 40 cm (16 in.) apart. Thin plants 5 to 8 cm (2 to 3 in.) apart.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 on pages 66 to 69 for individual recommendations based on a soil test analysis.

As a general recommendation, broadcast and incorporate 40 to 70 kg/ha (36 to 62 lb./acre) nitrogen, and 120 to 160 kg/ha (107 to 143 lb./acre) P_20_5. Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) potash (K_20). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. On well drained soils an application of 30 kg/ha (27 lb./acre) of **sulphate** sulphur (S) is recommended. For information on the application of different forms of sulphur fertilizer, see page 14.

Trace Elements

To prevent internal black spots, apply 22 kg/ha (20 lb./acre) borax along with the fertilizer, or spray with a foliar spray at 4.4 kg/ha (4 lb./acre).

Excess nutrients levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizers at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Stale Seedbed

Refer to Weed Control - Stale Seedbed, page 11.

Preplant Incorporated

Ro-Neet 7.2 E (720 g/L)

Controls annual grasses and several broadleaf weeds (Table 1). Apply 1.92 to 2.53 L/acre in 80 to 160 L/acre water. Immediately after application, thoroughly incorporate to a depth of 5 to 7 cm (2 - 3 in.) taking care to minimize loss of seedbed moisture. See Herbicide Information section in the Guide to Chemical Weed Control for application and incorporation instructions.

Pre-emergence

Bar-fox (83%), NaTa TCA (83%)

Controls green and yellow foxtail. Apply 2.49 to 3.99 kg/acre product NaTA TCA or 2.73 to 4.05 kg/acre product Bar-fox in 45 L/acre water before the beets emerge. Do not feed tops to livestock. Note: Since TCA acts primarily through the soil there will be variation in activity on different soils types and under different moisture conditions. For best results, soil should be moderately moist at the time of application.

Disease Control

Seed Decay, Damp Off

Treat seed with captan or thiram.

Storage

Roots should be stored at 0°C and relative humidity of 95%. Tap root should not be removed.

Cabbage, Cauliflower, Brussel Sprouts, Broccoli

Varieties

Cabbage

Early:

Golden Acre; Golden Cross Vela; Little Marvel; Tastie; Princess.

Mid Season:

Market Topper; Market Prize; Stonehead; Little Rock; Market Victor; Blue Heaven; Hinova (yellows-resistant); Hitoma (yellows-resistant).

Late: Summer

Danish Ballhead; Autumn Marvel.

Late: Winter

Falcon (yellows resistant); Decema; Renova; Lennox; Bartolo.

Red

Red Acre.

Chinese.

Michilli.

Cauliflower

Early:

Snowball Improved; Snowcap; Snow Crown.

Mid Season:

Imperial 10-6.

Late:

Snowball Y; Supermax; Taipan.

Brussel Sprouts

Jade Cross; Jade Cross E; Lancelot; Alcazar; Goldmine.

Broccoli

Premium Crop; Kayak; Southern Comet; Green Comet; Cruiser.

Seed Treatment

Treat seed with thiram or captan before seeding and apply according to manufacturer's directions.

Seeding

About 280 g seed provides sufficient transplants for each hectare (4 oz/acre). For direct seeding, use 2.2 kg/ha (2 lb./acre) and thin to the desired population. Direct seeded crops should be sown 12 to 19 mm (1/2 to 3/4 in.) deep

Spacing

Cabbage

Early crop transplants are set in the field in early May. Late cabbage is seeded directly about a week later (May 10 to 15).

Early:

Rows 76 cm (2 1/2 ft) apart, plants 38 to 45 cm (15 to 18 in.) apart.

Mid Season:

Rows 76 to 90 cm (2 1/2 to 3 ft) apart, plants 38 to 45 cm (15 to 18 in.) apart.

Late:

Rows 76 to 90 cm (2 1/2 to 3 ft) apart, plants 45 to 60 cm (18 to 24 in.) apart.

Cauliflower

Normally set transplants out into the field after the danger of frost is over. Mid season and late crops can be direct seeded.

Rows 76 cm (2 1/2 ft) apart, plants 45 to 60 cm (18 to 24 in.) apart.

Brussel Sprouts

Grown only from transplants which are set out into the field about May 20 - 25. The entire season is required for crop to reach maturity.

Rows 90 cm (3 ft) apart, plant spacing 53 cm (21 in.) apart.

Broccoli

Grown from transplants or seed. Early crops are set out as transplants, while late crops are direct seeded.

Rows 60 cm (2 ft) apart, plants 15 to 18 cm (6 to 7 in.).

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See Tables 4 to 7 at the back of this book for individual recommendations based on a soil test analysis.

For a general recommendation, broadcast and incorporate 60 to 100 kg/ha (54 to 89 lb./acre) of nitrogen, and 150 to 180 kg/ha (133 to 160 lb./acre) of phosphate (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. On well drained soils an application of 30 kg/ha (27 lb./acre) **sulphate** sulphur (s) is recommended. For information on the application of different forms of sulphur fertilizer, see page14.

Transplants

As cole crops respond favourably to a liberal application of nitrogen and phosphorus, use of a starter solution such as 20-20-20 is recommended. Mix at the rate of 454 g/45 L (1 lb./10 gal.) of water and apply 284 mL (10 ounces) per plant.

Note: *If necessary, additional nitrogen at the rate of 28 to 39 kg/ha (25 to 35 lb./acre) may be applied between the rows, or applied through the irrigation system about a month after seeding or transplanting.*

Borax

If the soils are known to be deficient in boron, apply 22 kg/ha (20 lb./acre) borax. It may be broadcast over the field and disced in before planting. If a foliar spray is used during the growing season, reduce the rate to 4.5 kg/ha (4 lb./acre) borax.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizers at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Stale Seedbed

See Stale Seedbed Weed Control at the beginning of the Horticulture section.

Preplant Incorporated

Rival (500 g/L), Treflan EC (545 g/L)

Use only on transplants of broccoli, brussel sprouts, cabbage or cauliflower and on directed seeded cabbage or cauliflower. Controls green and yellow foxtail and several broadleaf weeds (Table 1).

Trifluralin-resistant green foxtail has developed in Manitoba. Rival and Treflan will not control trifluralin-resistant foxtail. Refer to "Resistance of Weeds to Herbicides" in the current *Guide to Chemical Weed Control* for further information. For spring application only. Apply 0.65 to 1.13 L/acre of Rival or 0.61 to 0.81 L/acre of Treflan EC in at least 45 L/acre water. See Herbicide Incorporation section in the *Guide to Chemical Weed Control* for application and incorporation instructions. Rival and Treflan leave a residue in the soil which may affect subsequent crops.

Post-emergence

Excel (90 g/L)

Use on broccoli, cabbage and cauliflower only.

Controls several grassy weeds (Table 1). Apply 1.01 L/acre Excel in 45 L/acre water when the majority of grassy weeds are in the one to four leaf stage (do not apply if total leaves including tillers exceeds six leaves) and when volunteer corn is 5 to 24 cm (2 to 10 in.) tall. Apply with 80° or 110° stainless steel flat fan nozzles angled at 45° forward and use 40 psi (275 kPa) pressure. Apply no later than 60 days prior to harvest for cauliflower and no later than 44 days prior to harvest for broccoli and cabbage. A time interval of four days before or after application of excell is required before any other herbicide or chemical is applied. Do not apply Excel if rain is expected within three hours of application. Do not apply Excel by aircraft. Application of Excel in periods of stress will result in significantly reduced weed control. Reduced control is especially likely during periods of prolonged cool (12°C or less) or excessively hot (28°C) or greater day time temperature or low humidity.

Weed Resistance Note: *Excel-resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" in the current Guide to Chemical Weed Control for further information.*

Disease Control

Clubroot

Clubroot is an occasional problem in Manitoba but may become more frequent in occurrence if crop rotation is not followed. Follow a four year crop rotation and avoid all cole crops including canola (rapeseed) and mustard in the same rotation. Thoroughly clean all planting and harvesting equipment between fields. Use a pressurized washer and follow with a disinfectant.

Damping Off, Wirestem

Delay planting as long as possible to avoid cold, moist soils which favor disease development. Grow transplants in fumigated soil. Space seedlings in seed beds to allow air circulation around the plants. Dust seed with captan or thiram before planting.

Cabbage, Cauliflower, Brussel Sprouts, Broccoli

Disease, Cultural Control	Pesticide Days &Restrictions to Harvest	Product per acre	Comment
Downy Mildew (Broccoli and cauliflower heads.Avoid overwatering particularly in the late afternoon. Incorporate crop remains as soon as harvest is complete.	Bravo 500	1.012-1.943 L	7
	Bravo W75	0.729-1.315 kg	7
	Tri-basic Copper sulfate	1.1619 kg	1
	Copper 50W	1.821 kg	1
	Copper oxychloride 50	1.619 kg	1
	Maneb 80W	0.911 kg	7
	Manzate D	0.911 kg	7
	Zineb 80W	0.445-1.335 kg	7
Alternaria, Black leaf sport, grey spot	Tri-basic Copper	1.1619 kg	1
	Bravo W75	0.729-1.315 kg	7
	Maneb 80W	0.911 kg	7
	Manzate D	0.911 kg	7
	Zineb 80W	0.445-1.335 kg	7

Bacterial Soft Rot and Watery Soft Rot (Sclerotinia)

Avoid injury to plants in cultivation or at harvest and use plant spacing that allows for good air circulation. Control root maggots, slugs and other chewing insects. Disinfect storage bin with two per cent copper sulphate solution or other disinfectant before storing the crop. Follow a three year crop rotation and avoid other cole crops, beans, lettuce, carrots and celery. Rotate with cereals, corn, onions and beets.

Blackleg, Black Rot

Sow hot water treated seed. Treat in 50°C water for 25 minutes for cabbage and brussel sprouts and 15 minutes for cauliflower or broccoli. Avoid working in field when plants are wet. Follow a three year crop rotation.

Brown Heart (Boron Deficiency) See Fertilizer Section.

Fusarium Yellows

Fusarium yellows is an occasional problem in Manitoba but once the disease is established in a field it can cause complete crop loss of susceptible cabbage varieties. Long rotations of three or more years are required to reduce the incidence of Fusarium fungus in the soil. There are varieties available that have good resistance to Fusarium yellows and these are presently being evaluated in Manitoba.

Special Problems

Cabbage Splitting

Well developed heads may split if heavy rains follow a prolonged dry spell. The splitting is caused by rapid growth promoted by improved growing conditions. Maintaining uniform growth with proper irrigation may partially prevent this.

Cauliflower Buttoning

This is identified by the formation of a small head before the plant is mature enough to support it. It causes the head to remain small and unmarketable. It may be the result of:

- Overhardening of the young plants.
- Unbalanced soil fertility.
- Too low moisture supply.
- Weather extremes and cold weather (4° to 10° C) for 10 days or more, especially under conditions of excess soil moisture.

An application of 45.5 kg/ha (100 lb./acre) of 34-0-0, through the irrigation system may assist in rectifying the problem. Application should be made as soon as possible after stress conditions occur.

Harvest and Storage

Cabbage and Brussel Sprouts

Cabbage heads are harvested after they have become firm. Brussel sprouts are harvested when sprouts are 2.5 to 5 cm (1 to 2 in.) diameter. Sprouts are best stored on the stock for longer storage life. Sprout development is improved and made more uniform by pinching the growing point of the plants when the middle sprouts are about 12 to 19 mm (1/2 to 3/4 in.) in diameter. Both crops store well at a temperature of 0°C and a relative humidity of 100%. To retain the rich green color, field heat must be removed immediately after entering storage. Most green coloring will disappear unless the temperature is reduced within the first week of storage.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Aphids	Cygon 480EC (not registered on cauliflower)	0.283-0.405 L		4-broccoli;21-brussel sprouts; 7-cabbage, cauliflower:
	Diazinon 500 EC	0.445 L		5 (7 for cabbage)
	Di-Syston 15G	See label		21 (42 for broccoli)
	Di-Syston LC	See label		21-brussel sprouts, cauliflower; 42-broccoli, cabbage
	Guthion SC	0.910-1.416 L		15-broccoli, cauliflower; 7-brussel sprouts; 21-cabbage
	Malathion 500EC	0.567-1.214 L		7 (3 for broccoli)
	Monitor 480	0.445-0.910 L		7
	Rotenone D (cabbage, cauliflower only)	12.141-16.187 kg		
	Thiodan 4EC	0.556-0.850 L		7
Cabbage worms, Loopers, Diamond-back moth	Bacillus thuringiensis		See label	
	Ambush 500 EC	0.028-0.056 L		3 (7 for broccoli)
	Belmark 30 EC (do not use on broccoli)	0.061-0.131 L		14
	Decis 5 EC (use in 142-223 L water per acre)	0.061-0.081 L		3
	Diazinon 500 EC	0.445 L		5-broccoli, cauliflower, brussel sprouts 7-cabbage
	Guthion SC	0.910-1.416 L		15-broccoli, cauliflower; 21-cabbage; 7-brussel sprouts
	Lannate L	0.506-0.910 L		7 (1 for cabbage)
	Malathion 500 EC (registered for cabbage worm and looper only)	0.566-1.214 L		7
	Monitor 480 L	0.445-0.910 L		7
	Ripcord 400	0.035-0.050 L		3
	Rotenone D (cabbage & cauliflower only)	12.141-16.187 kg	Apply to foliage to control cabbage looper and imported cabbage worm.	
	Sevin XLR	1.012-2.125 L		3
	Thiodan 4EC	0.566-0.850 L		7
Flea Beetles	Ambush 500 EC	0.028-0.057 L		3(7 for cauliflower)
	Di-Syston 15G & LC		See label	42-broccoli, cabbage; 2- cauliflower, brussel sprouts
	Diazinon 500 EC	0.445 L		5
	Malathion 500 EC	0.566-1.214 L		7
	Sevin XLR	0.506-1.012 L		3
	Ripcord 400 EC	0.035-0.050 L		3
	Rotenone D (cabbage & cauliflower only)	12.141-16.187 kg		
	Thiodan 4EC	0.567-0.850 L		7
Root Maggots	Dasanit 15 G & SC		See label	
	Diazinon 50W & 5G		See label	
	Lorsban 4E		See label Do not apply to brussel sprouts	32
Thrips	Diazinon 500 EC (do not use on brussel sprouts)	0.445-0.810 L (cabbage) 4.445 L (broccoli, cauliflower)		5-broccoli, cauliflower; 7-cabbage

Cauliflower

Harvest heads when they are 15 cm (6 in.) or more in diameter and before the curd begins to separate and "rice". Tying up the leaves to enclose the head is usually necessary to produce a bright white curd.

Broccoli

Heads should be harvested when the flower bud clusters are well formed, but before yellow flowers appear. The terminal bud is the largest and forms first, followed by the laterals. Broccoli heads should be trimmed to a length of about 15 cm (6 in.).

Cauliflower and broccoli will store for short periods of time if the field heat is removed immediately after harvest. For broccoli, storage quality is maintained at a much higher level if the product is covered with a layer of crushed ice (slush) after it is packed in the container ready for shipment. This helps prevent dehydration while it is moving through the distributive trade.

Carrots

Varieties

Fresh Market

Six Pak; Hipack (main crop); Sierra; Paramount

Processing

Spartan Bonus 80; Dess Dan; Nandrin F.

Seeding

Seedbed Preparation

Deep fall-plowing 20 to 35 cm (8 to 10 in.) followed by spring tillage will leave a fine seedbed for uniform germination. Prepare land in three or four row beds to prevent compacted tire tracks in growing area.

Rates

For Nantes types, optimum stand is 10 to 16 carrots per 30 cm (1 ft) of row; for Imperator types, a stand of 12 to 18 plants per 30 cm (1 ft) of row is recommended.

Row Spacing

40 to 50 cm (16 to 20 in.) apart.

Depth

Seed depth of 2 to 2.5 cm (3/4 to 1 in.) deep is most satisfactory. Since the seed is very small, at no time should it be planted more than 2.5 cm (1 in.) deep.

Dates

Early crop - May 10 to 15
Storage crop - May 24 to 31

Irrigation

The carrot is not tolerant to drought or high temperatures, it needs steady and relatively large amounts of water for optimum growth. If high temperature conditions exist when seedlings are just emerging, irrigation will prevent serious damage to the young plants. Irrigation can be used very effectively to overcome heavy soil crusting that can reduce the stand if not controlled.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 at the back of this book for individual recommendations based on a soil test analysis.

Carrots have shown little response to chemical fertilizer in Manitoba, except when grown on relatively light soils low in nutrients. Where soil fertility is low (according to soil tests) apply nutrients according to tables 4 to 7.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizers at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Stale Seedbed

Refer to Weed control - Stale Seedbed, page 11.

Preplant Incorporated

Rival (500 g/L), Treflan EC (545 g/L)

Controls green and yellow foxtail and several broadleaf weeds (Table 1). **Trifluralin-resistant green foxtail has developed in Manitoba. Rival and Treflan will not control trifluralin-resistant foxtail. Refer to "Resistance of Weeds to Herbicides" in the current Guide to Chemical Weed Control for further information.** For spring application only apply 0.65 to 1.13 L/acre of Rival or 0.61 to 0.81 L/acre of Treflan EC in at least 45 L/acre of water. See Herbicide Incorporation section in the Guide to Chemical Weed Control for application and incorporation instructions. Rival and Treflan leave a residue in the soil which may affect subsequent crops.

Pre-emergence

Afolan F (480 g/L), Linuron 400L (400 g/L), Lorox L (48 g/L) and Lorox DF (50%)

Controls barnyard grass, green and yellow foxtail and several broadleaf weeds (Table 1). Apply after planting but prior to crop emergence:

	Rates	
Herbicide	**Loam or clay soils with muck or clay soil**	**Low organic matter with medium organic matter**
Afolan F	0.53 to 0.77 L/acre	0.77 - 1.01 L/acre
Linuron 400L	0.61 to 0.81 L/acre	0.81 - 1.11 L/acre
Lorox L	0.45 L/acre	1.38 L/acre
Lorox DF	0.44 kg/acre	1.31 kg/acre

Do not use on sandy or coarse textured soils low in organic matter (less than 3%). Plant seed at least 1.5 cm (0.6 in.) deep. Rain or irrigation is needed to carry the chemical into the root zone to germinating weeds. If unusually heavy rains follow application, severe injury to carrots may result. Do not replant to any other crop within four months after application.

If initial seeding of carrots fails to produce a stand, the same crop may be reseeded into soil treated with these herbicides. Thoroughly rework soil before replanting. Do not retreat field with second application of Linuron 400 L or Afolan F or Lorox as injury to the crop may result. Do not make more than one application per season.

Postemergence

Afolan F (480 g/L), Lorox L (480 g/L), Lorox DF (50%)

Apply only if carrots have not had a pre-emergence treatment of Afolan F, Linuron 400L or Lorox. Controls barnyard grass, green and yellow foxtail and several broadleaf weeds (Table 1). Apply Afolan F at 0.77 to 1.9 L/acre or Lorox L at 0.91 to 1.82 L/acre or Lorox DF at 0.91 to 1.82 kg/acre in 90 to 130 L/acre water. Follow detailed mixing instructions on the product label. Use 50 mesh or larger line strainers or screens. A pump of sufficient capacity to provide adequate volume through the bypass and/or jet agitation system must be used. This will prevent settling-out while spraying.

Do not apply with greater than 40 psi (275 kPa) pressure. Spray when carrots have two or more fully developed leaves. Use lower rates on small seedling weeds and higher rates on larger established weeds. Apply before annual grasses exceed 5 cm (2 in.) height or before broadleaf weeds exceed 15 cm (6 in.). During hot, dry weather, spray in the cool part of the day to avoid injury. Note: Plant seed at least 1.3 cm (0.5 in.) deep. Do not apply when temperature exceeds 32°C, as crop injury may result.

Note: *Afolan F or Lorox may be applied following Agricultural Weedkiller No. 1, provided treatments are at least one day apart. Agricultural Weedkiller No. 1 may be applied following Afolan F or Lorox L, allowing a two week interval between application of Afolan F or Lorox L and Agricultural Weedkiller No. 1. Shorter intervals may cause crop damage. Do not tank mix Afolan F or Lorox L with Agricultural Weedkiller No. 1 or surfactants.*

Agricultural Weedkiller No. 1 (100%)

Controls barnyard grass and several broadleaf weeds Table 1). Apply 240 to 320 L/acre as an overall treatment when carrots are in the two to four leaf stage and before weeds are 10 cm (4 in.) tall. Spray in evening when humidity is high and winds are light. Do not apply within 30 days of harvest. **Caution: See note under Afolan F/Lorox recommendation.**

Fusilade (250 g/L)/Fusilade II (125 g/L)

Controls several grassy weeds (Table1). Apply the rate appropriate for the weeds to be controlled as outlined in the following table:

Weed	Leaf Stage (L/Acre)	Rate
volunteer corn	2-5	0.2
barnyard grass	2-4	0.324
volunteer wheat		
volunteer barley		
wild oats, proso millet	2-4	0.405
green and yellow foxtail	2-4	0.57
quackgrass suppression	3-5	0.81

Apply when the crop is 10 cm (4 in.) in height and when weeds are in the leaf stages recommended in the table. Do not apply within 50 days of harvest. Use 45 to 120 L/acre of water using flat fan nozzles and a pressure of 30 to 40 psi (200 to 275 kPa). If using Fusilade (250 g/L), add Agral 90 at a rate of 0.1 L/100 L spray solution. Do not apply after tillering of annual grass weeds. For quackgrass suppression, ensure that rhizomes are thoroughly fragmented by tillage prior to seeding. Quackgrass plants more than 20 cm (8 in.) in height or which have reached the heading stage will not be controlled. Poor results may occur if plants are stressed by lack of moisture, excess moisture, flooding, low temperatures or very low relative humidity. Do not apply if rainfall is expected within 2 hours of application. Do not tank mix with other herbicides or fertilizers. Other herbicides must be applied 3 days after Fusilade/Fusilade II applications. Do not reseed sensitive crops within 60 days of application.

Experimental feeding studies have demonstrated that the active ingredient in these products can produce birth defects and other adverse effects in the developing fetuses of laboratory animals. Women capable of bearing children should avoid contact with this product.

Hoe-Grass 284 (284 g/L)

Controls wild oats, green and yellow foxtail and barnyard grass (Table 1). Apply 1.42 L/acre in at least 45 L/acre water at a nozzle pressure of 40 psi (275 kPa). Direct nozzles 45° forward. Apply when the weeds are in the one to four leaf stage and before they tiller. Other postemergence herbicides must be applied at least four days after Hoe-Grass 284 application. Do not apply if rain is expected within one hour. Do not apply within 60 days of harvest. Application under hot weather (above 27°C) or drought conditions will reduce weed control.

Weed Resistance Note: *Fusilade/Fusilade II - resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in your current Guide to Chemical Weed Control for further information.*

Lorox L

See Afolan F.

Disease Control

Aster Yellows

Control leafhoppers that spread the mycoplasma (see insect control). Avoid growing carrots near forage legumes or other areas where leafhopper populations are high.

Disease Control

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days To Harvest
Leaf spots	Tri-basic copper sulfate	1.619 kg	Spray every 7 to 14 days depending on weather conditions	1
	Dithane M22	0.445-1.315 kg		5
	Dithane M45	0.911 kg		7
	Manzate 200	0.911 kg		7
	Polyram 80W	0.911 kg		5
	Maneb 80W	0.911 kg		5
	Manzate D	0.445-1.315 kg		5
	Zineb 80W	0.445-1.315 kg		7
Early and Late Blight	Bravo 75W	0.708 - 0.890 kg		1
	Bravo 500	0.971 - 1.295 L		1
	Polyram 80W	0.911 kg		5
	Zineb 80W	0.445-1.315 kg		7

Bacterial Soft Rot and Watery Soft Rot (Sclerotinia)

Handle the crop carefully to avoid wounds. Cull during harvest if rots are present. Disinfect storage area before storage using a 2 per cent solution of copper sulphate (for example, 1 kg/50 L water or 2.00 lb./10 gallons water). Allow storage area to dry before storing carrots. Follow a crop rotation of three years between successive crops. Rotate with onions, beets, cereals or corn. Avoid beans, lettuce, parsnips, cole crops including canola (rapeseed), peas, lentils, cucumber and celery since all are susceptible to Sclerotinia. For a listing of field crops susceptible to sclerotinia disease consult the current *Field Crop Production Guide for Manitoba*. Carrots harvested during warm weather should be cooled as quickly as possible.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Leafhoppers	Diazinon 50W	See label		10
	Furadan 10G	9.106 kg	For prevention of aster yellows, apply at time of seeding	
	Malathion 500 EC	0.566 - 1.214 L	When infestations remain high after late July, spray twice weekly.	7
	Sevin XLR Use lower rates on young plants)	0.506 -1.012 L		1

Special Problems

Greening

Constant hilling throughout the growing season is essential to prevent green-shouldered carrots.

Off-Shape Roots

These may be caused by:

- lack of stand.
- poorly prepared seedbed.
- excess moisture at certain periods.
- excessive packing of soil by equipment.

Browning

Caused mainly from excessive drying of roots following harvest, such as:

- harvesting in excessive heat.
- neglecting to remove carrots from field immediately after harvest.
- lack of cooling facilities in storage.
- excessive drying in storage through lack of humidity controls.

Preventive Measures

- harvest under cool conditions when possible.
- prevent drying from field to storage.
- remove field heat rapidly after carrots have entered storage.
- maintain humidity of storage at 100 per cent and temperatures at 0°C.
- soaking pile periodically after carrots are in storage helps prevent drying and aids in removing field heat.

However, this practice may favor development of Sclerotinia soft rot in stored carrots.

Celery

Varieties

Utah 52-70.

Seed Treatment

Purchase hot-water treated seed or use three-year-old seed to avoid seed-borne blight disease. Treat seed with a fungicide such as captan (according to directions on label) before planting in flats. Seed germination is normally slow and often takes up to 20 days from seeding.

Transplants

Allow 10 to 12 weeks to produce plants for field planting. As a rule of thumb, 210g of seed produces sufficient transplants for 1 hectare (3 ounces for 1 acre). The general practice has been to plant celery at 30 x 30 cm (12 x 12 in.) spacing.

A starter solution such as 20-20-20 is recommended. Mix 454 g (1 lb.) fertilizer/45 L (10 gal.) water and apply 0.280 to 0.300 L (one-half pint) per plant.

Temperatures of 21° to 24°C are quite suitable for germination. The regular growing temperature should be held at 18° to 21°C. If plants are subjected to temperatures of 2° to 10°C "bolting to seed" occurs. The amount of bolting increases as the period of exposure to cool temperatures is lengthened. Thus, plants should not be set in the field until the danger of a prolonged cool period is over. They may be hardened, if desired, by withholding water for the last 7 to 10 days before setting in the field. Do not harden off plants by lowering the temperature. Clip the tops once or twice while the plants are in the flats to develop sturdier seedlings.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See Tables 4 to 7 at the back of this book for individual recommendations based on a soil test analysis.

For general recommendation, broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb./acre) of nitrogen and 150 to 180 kg/ha (134 to 161 lb./acre) of phosphate (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 170 to 200 kg/ha (152 to 178 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, reduce the above rate by one-half. On well drained soils the application of 30 kg/ha (27 lb./acre) sulphate sulphur (S) is recommended. For information on the application of different forms of sulphur fertilizer, see page 13.

If cracked stems have been a problem, boron should be added as borax at 17 kg/ha (15 lb./acre). With foliar application, reduce the rate of borax to 4.5 kg/ha (4 lb./acre).

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Disease Control

Aster Yellows

Control the leafhopper which spreads the mycoplasma. Refer to the Insect Control Section. Avoid growing celery near forage legumes or other areas where leafhopper populations are high.

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Early and Late Blight (Use disease-free seed, seed that's more than 2 years old or hot water treated at 48° C for 30 minutes. Disease favoured by wet conditions later in the season).	Bravo 500	0.647-1.619 L	Starting mid July, spray every 7-10 days depending on weather conditions	7
	Dyrene 50WP	0.911-1.416 kg		7
	Fixed Copper 53	1.214-1.619 kg		1
	Fixed Copper 50W	1.821 kg		1
	Copper 50W	1.315-2.732 kg		1
	Tri-basic Copper sulphate	1.214 - 2.631 kg		1
	Folpan 50WP	0.809 kg		7
	Phaltan 75WP	0.506 kg		7
	Bravo W75	0.708-1.113 kg		7
	Dithane M22	0.445 - 1.315 kg		14
	Maneb 80W	0.911 kg		14
	Manzate D	0.445 - 1.315 kg		14
	Dithane M45	0.911 kg		14
	Manzate 200	0.911-1.315 kg		14
	Polyram 80WP	0.911-1.315 kg		14
	Polyram 7D	13.52 - 20.235 kg		14
	Polyram DF	0.890-1.315 kg		14
	Zineb 80W	0.445-1.335 kg		14
Black Heart (Physiological) (Maintain uniform moisture in the field Avoid excess application of fertilizer.)	calcium nitrate	0.405 - 0.809 kg	Apply in 184 L of water/acre every 7-10 days during periods when disease threatens especially during cloudy warm weather.	
	Calcium chloride	0.202 - 0.405 kg		

Weed Control

Postemergent to weeds, 8 to 10 days after transplanting and new growth has started.

Afolan F (480 g/L)

Controls barnyard grass, green and yellow foxtail and several broadleaf weeds.(Table 1). Apply 0.77 to 1.01 L/acre in 80 to 160 L/acre water on loam or clay soils with low organic matter or 1.01 to 1.9 L/acre in 80 to 160 L/acre on muck or clay soil with medium organic matter. Do not apply under hot conditions. Do apply with greater than 275 kPa (40 psi) pressure. Read product label for detailed mixing instructions. Use 50 mesh or larger screens and line strainers. A pump of sufficient capacity to provide adequate volume though the bypass and/or jet agitation system must be used. This will prevent settling out while spraying.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Aphids	Malathion 500 EC	0.809 L		7
	Thiodan 4EC	0.850 L		14
Leafhoppers	Cymbush 250 EC	0.057 L		7
	Malathion 500 EC	0.809 L	Spray twice weekly from time of emergence	7
	Sevin XLR	0.506-1.012 L		3

Harvest and Storage

Celery is cut 2.5 to 5.0 cm (1 to 2 in.) below the crown. Trim the coarse outer leaves. Prior to storage, the field heat should be removed as quickly as possible - ideally with hydrocooling. Celery will last up to two months in storage with a minimum of loss if held at 0°C and a relative humidity of 95 per cent.

Corn (Sweet)

Varieties

Regular Sweet:

Early:

Earlivee, Spartan

Super Sweet (S.S.):

Early:

Northern Super Sweet, 6700Y

Main:

Sweet Treat, Sweetie 73, XPH2623SH2

Late:

Sweet Belle, Spring Sweet, 7210Y

Sugary Enhanced (S.E.)

Main:

Maple Sweet

Seeding

Soil temperature should be above 13°C for rapid and vigorous germination.

Date

May 15 approximately.

Rate

11 to 13 kg/ha (10 to 12 lb./acre).

Spacing

Rows 76 to 95 cm (30 to 42 in.) apart (depending on machinery for cultivation). Plant 20 to 25 cm (8 to 10 in.) apart in the row for early varieties, and 25 to 32 cm (10 to 12 in.) for main crop varieties.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See Tables 4 to 7 at the back of the book for individual recommendations based on a soil test analysis.

All nitrogen, phosphate and potash should be banded at time of seeding, if possible. The total amount of fertilizer material side-banded should not exceed 340 kg/ha (303 lb./acre). Nitrogen requirements not side-banded at time of seeding should be side-dressed before the corn is 15 cm (6 in.) high.

Excess nutrient levels may occur when high rates of fertilizer are used on continuous corn. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Stale Seedbed

See Stale Seedbed Weed Control in the current *Guide to Chemical Weed Control.*

Preplant Incorporated

Dual (960 g/L)

Controls green and yellow foxtail and barnyard grass. (Table 1). Apply 0.81 to 1.11 L/acre in a minimum of 60 L/acre water. Use the higher rate for heavy weed infestations. Incorporate in the top 5 cm (2 in.) of soil with a tandem disc, vibrating shank cultivator or harrows set to work the soil no deeper than 10 cm (4 in.). Immediate incorporation is not required. Do not use on peat or muck soils. Heavy rainfall conditions following application of Dual may result in reduced weed control, especially on sandier soil types. See Herbicide Incorporation section of *Guide to Chemical Weed Control* for incorporation instructions.

General Rate of Nutrient to Add

	Nitrogen (N)		Phosphate (P_2O_5)		Potash (K_2O)		Sulphur (S)	
Corn to be grown on	**kg/ha**	**lb./acre**	**kg/ha**	**lb./acre**	**kg/ha**	**lb./acre**	**kg/ha**	**lb./acre**
Fallow or legume breaking (2)	0-30	0-27	30-45	27-40	(3)	(3)	(4)	(4)
Grass and grass-legume breaking (2)	30-75	27-67	30-45	27-40	(3)	(3)	(4)	(4)
Stubble	75-150	67-134	30-45	27-40	(3)	(3)	(4)	(4)

(1) Rates are based on granular nitrogen applied broadcast at or near seeding time. See Nitrogen section, page 12.

(2) Refers to breaking after first cut of forage.

(3) Sands, sandy loam and organic soils are frequently low in available potassium. On these soils apply 30 to 110 kg/ha, (27 to 98 lb./acre) of potash (K_2O). If the potassium fertilizer is broadcast applied, the rate should be doubled.

(4) Twenty kg/ha (18 lb./acre) of sulphate sulphur (S) are recommended on well-drained soils. Sulphur deficiency may occur in many other soils and in any area of the province. Because of this, a soil test is recommended to establish the available sulphur status of your fields. For information on the application of different forms of sulphur fertilizer see page 14.

Eradicane 8-E (800 g/L)

Controls several grasses and broadleaf weeds (Table 1). Apply at 1.72 to 2.23 L/acre in at least 45 L/acre water to the dry soil surface of a well prepared seedbed. Spray and incorporate immediately. Plant seed to a maximum depth of 5 cm (2 in.). See Herbicide Incorporation section of the Guide to Chemical Weed Control for information on incorporation.

The level of weed control may be reduced when Eradicane is used on soils which have been treated with Eradicane, Eptam or Sutan+ the previous growing season. It is anticipated that the reduction in control will be greater where Eradicane, Eptam or Sutan+ has been used repeatedly for two or more years.

Primextra (500 g/L)

Controls green and yellow foxtail, barnyard grass, and several broadleaf weeds (Table 1). Apply 2.71 to 3.44 L/acre in a minimum of 60 L/acre water. Do not use on peat or muck soils, or on coarse textured soils low in organic matter. Use the higher rate when heavy weed infestations are expected. Incorporate thoroughly into 5 cm (2 in.) of soil prior to planting. Immediate incorporation is not necessary. Heavy rainfall conditions following application of Primextra may result in reduced weed control, especially on sandier soil types. See Herbicide Incorporation section of the Guide to Chemical Weed Control for incorporation instructions. This treatment may leave a residue in the soil the following year.

Primextra contains atrazine. Any treatments containing atrazine leaves a residue in the soil which may affect the subsequent crop. For corn in rotation with other crops, non-residual treatments are preferred to allow cropping flexibility. Triazine tolerant canola is tolerant to residues from field applications of atrazine. Flax, peas and fababeans have some tolerance and are usually not affected by residues from recommended rates of Primextra. Other crops should not be sown the year following Primextra application.

Postemergence

For corn less than 15 cm (6 in.) tall (leaf outstretched) the following treatments may be applied as an overall spray.

Basagran (480 g/L)

Controls several broadleaf weeds (Table 1). Apply 0.71 to 0.91 L/acre in 80 to 160 L/acre water. Add Assist Oil Concentrate at 0.81 L/acre. Reduce Assist Oil Concentrate to 0.405 L/acre under hot, humid weather conditions. Use the lower rate to control lady's thumb and annual smartweed species 2.5 to 7.5 cm (1 to 3 in.) high, wild mustard 2.5 to 12.5 cm (1 to 5 in.) high, or cocklebur 7.5 to 17.5 cm (3 to 7 in.) high. Use the higher rate to control lady's thumb and annual smartweed species 7.5 to 20 cm (3 to 8 in.) high, wild mustard 12.5 to 25 cm (5 to 10 in.) high, cocklebur 17.5 to 30 cm (7 to 12 in.) high, and seedlings of other susceptible weeds.

Basagran also suppresses top growth of Canada thistle and field bindweed (patch treatment). Apply a split application of 0.71 L/acre plus 0.71 L/acre 7 to 15 days later. Apply in 80 to 160 L/acre water, when thistles are 15 to 20 cm (6 to 8 in.) tall and when field bindweed has developed a dark green color and before it has begun trailing. Add Assist Oil Concentrate at 0.81 L/acre. Reduce Assist Oil Concentrate to 0.405 L/acre under hot, humid weather conditions.

Best results are obtained when Basagran is applied under warm temperatures (21°C or higher). Cool weather or drought will delay herbicidal activity and if prolonged, may result in poor weed control. Use of Basagran in hot, humid weather may result in temporary leaf yellowing, leaf flecking, bronzing or burning.

Buctril M (560 g/L)

Controls several broadleaf weeds (Table 1). Apply 0.405 L/acre in 80 to 120 L/acre water at a pressure of 40 psi (275 kPa) when corn is in the 4 to 6 leaf stage and weed seedlings are small. Leaf scorch may occur if application is made under hot, humid conditions or under excessively cool, wet weather.

Kil-Mor (485 g/L)

Controls several broadleaf weeds (Table 1). Apply 0.343 to 0.445 L/acre in a minimum of 80 L/acre water as an overall spray before corn reaches 15 cm (6 in.) in height (top leaf extended) and before weeds reach 10 cm (4 in.) in height.

Do not apply Kil-Mor when temperatures are above 27°C and the relative humidity is high. Under certain environmental conditions (eg. extended periods of either cold or hot, dry weather), corn may become brittle after applying Kil-mor. Do not cultivate for 2 weeks following application. Heavy winds during the 2 week period following application may cause some stalk lodging.

Do not apply Kil-Mor in the interval between 15 to 30 cm (6 to 12 in.) in height of corn. For corn over 15 cm (6 in.) tall see Directed Postemergence recommendation in this section.

2,4-D Amine

Controls several broadleaf weeds (Table 1). Apply 0.339 to 0.45 L/acre of formulations containing 500 g/L 2,4-D amine in 45 L/acre water as an overall spray until corn is 15 cm (6 in.) tall (leaf outstretched), after which a directed spray should be used. See Directed Postemergence recommendations in this section. For product volumes of other formulations of 2,4-D Amine see Table 21 in the Guide to Chemical Weed Control.

For corn over 15 cm (6 in.) tall the following treatments may be applied as an overall spray.

Pardner (280 g/L)

Controls several broadleaf weeds (Table 1). Apply 0.405 to 0.485 L/acre in at least 80 to 120 L/acre water. Apply when corn is in the 4 to 8 leaf stage and before the weeds are past the 4 leaf stage. Do not use under conditions of high humidity and high temperature (higher than 27°C) or crop injury may occur.

Directed Postemergence

For corn over 15 cm (6 in.) tall (leaf outstretched). Application of these herbicides requires positioning of the nozzles to direct spray to the base of the corn plant. Severe damage is likely if the crop leaves are sprayed.

Kil-Mor (485 g/L)

Controls several broadleaf weeds (Table 1). Do not apply Kil-Mor to corn between 15 to 30 cm (6 to 12 in.) in height. When the crop is beyond 30 cm (12 in.) in height apply using drop nozzles. Do not allow the spray solution to contact the corn stalk above the point where the first leaf meets the stem. Apply 0.343 to 0.445 L/acre in a minimum of 100 to 120 L/acre of water.

Under certain environmental conditions (eg. extended periods of either cold or hot, dry weather), corn may become brittle after applying Kil-mor. Do not cultivate for 2 weeks following application. Heavy winds during the 2 week period following application may cause some stalk lodging. Do not apply when temperatures are above 27°C and the relative humidity is high.

2,4-D Amine

Controls several broadleaf weeds (Table 1). Apply 0.61 L/acre of formulations containing 500 g/L 2,4-D amine in 45 to 90 L/acre water according to the species and stage of weeds present. Treat by directing spray to base of plant after corn is more than 15 cm (6 in.) tall (leaf outstretched). For product volumes of other formulations of 2,4-D amine, see Table 21 in the *Guide to Chemical Weed Control.*

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
European corn borer and corn earworm	Ambush 500 EC	0.081 - 0.111 L	Spray twice or 1 more when 15% or more plants show leaf feeding in the whorls (early July)	5
	Cymbush 250 EC (European corn borer only)	0.113 L		
	Furadan 480 F (European corn borer only)	0.445 L		7
	Lannate L (European corn borer only)	1.052 L		3
	Lannate (Corn earworm only)	0.728-1.052 L		3
	Ripcord 400 EC	0.0701 L		5
	Rotenone D (European corn borer only)	14.164 - 18.211 kg		
	Sevin XLR	1.012 - 1.619 L		1
	Thiodan 4EC(Corn earworm only)	1.133 - 1.700 L		50

Bee Poisoning Warning

Bees often visit sweet and field corn to collect pollen. While spraying is being done, bee poisoning may result.

Sevin, Furadan and Ambush are highly toxic to bees, but Sevin is the most damaging since it is carried to the hive and poisons the brood.

If bees are in the area, advise local beekeepers of spraying activity and do not use Sevin. Your local agricultural representative has a list of beekeepers in your area.

Bee poisoning is reduced when sprays are applied in early morning or late evening when bees are not foraging. Do not treat when the wind is blowing. Avoid spray drift to roadsides and adjacent fields where plants may be in bloom.

Disease Control

Treat seed with Captan 75 or Thiram 75 seed protectants.

Leaf Blights, Stalk Rots and Ear Rots

Follow a crop rotation which allows three years before replanting the field to corn; rotate with crops other than cereals and grasses. Maintain balanced soil fertility and avoid high nitrogen levels.

Common Smut

To prevent spread of smut, cut off and destroy smut balls before they open. Follow a two year crop rotation.

Head Smut

To prevent introduction of head smut, plant seed treated with a seed dressing containing Vitaflo 280. If disease is found in a field rotate field with special crops for two years.

Seed Decay, Damp Off

Treat seed with captan, or thiram.

Harvesting and Storage

Sweet corn is harvested when the kernel is fully formed but still tender. Most varieties reach this stage about the time the silk turns brown or approximately three weeks after the silks first appear. Until familiar with outward signs, test for readiness by pressing the tip kernels with your fingernail. The milky contents of the kernel should spurt out when pressure is applied.

Harvested corn must be cooled rapidly - ideally by hydrocooling. It must be held at below 5°C and at high humidity, or it will lose quality very quickly. After harvest, sweet corn should be marketed in the shortest possible time.

Cucumbers

Varieties

Pickling

Green Spear 14; Perfecto Verde; Alouette; Carolina.

Slicing

Burpeeana Hybrid; Burpee's Hybrid; Marketmore; Burpless Hybrid; Victory.

Bread & Butter

Japanese Long; China

Seed Treatment

Apply captan or thiram to the seed according to manufacturer's instructions.

Seeding

Cucumbers are frost tender, thriving only if weather is warm. Delay seeding and transplanting until late May and early June when soil temperatures are 16°C or higher. Cucumbers may be raised either from transplants for early crops or from direct seeding in the field. About 2.2 kg/ha (2 lb./acre) of seed is required to produce enough transplants for one hectare.

For direct seeding of cucumbers, 4.5 to 5.5 kg/ha (4 to 5 lb./acre) are required.

Sow cucumbers at a depth of 1.3 to 2.5 cm (1/2 to 1 in.).

Suggested spacing requirements: rows 1.2 to 1.8 m (4 to 6 ft.), plants 30 to 38 cm (12 to 15 in.) apart.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 for individual recommendations based on a soil test analysis.

When using transplants, the application of a starter fertilizer such as 10-52-17 or 10-40-10 is recommended. Mix at a rate of 454 g (1 lb.) fertilizer in 45 L (10 gal.) water and apply 284 to 300 mL (10 oz.) per plant.

As a general recommendation, broadcast and incorporate 20 to 60 kg/ha (18 to 54 lb./acre) of nitrogen, and 120 to 160 kg/ha (107 to 143 lb./acre) phosphorus (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. On well drained soils an application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended. For further information on the application of different forms of sulphur fertilizer, see page 13.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Irrigation

Good moisture is necessary throughout the growing season. Irrigate to supply 2.5 cm (1 in.) water after seeding or transplanting. Good moisture reserves are also necessary at time of flowering and fruit development. Do not let soil dry out during this period. Irrigate in the late afternoon or evening to avoid bees working the field.

Pollination

All vine crops depend on insects to transfer pollen from male to female blossoms. These are borne separately on the same plant. To ensure adequate pollination, introduce one colony of honeybees for every 2 to 3 acres.

Weed Control

Stale Seedbed

Refer to Weed Control - Stale Seedbed, page 11.

Preplant Incorporated

Alanap 3 (240 g/L)

Controls green and yellow foxtail and several broadleaf weeds (Table 1). Apply 3.84 to 7.69 L/acre Alanap 3. Apply in 100 to 120 L/acre water. Incorporate lightly 1 to 3 cm (0.4 to 1.2 in.). Use lower rate on light sandy soils.

Prefar (480 g/L)

Controls barnyard grass, green and yellow foxtail.(Table 1). Apply 4.86 to 5.67 L/acre in 45 to 200 L/acre water.

Incorporate 2.5 to 5 cm (1 to 2 in.) deep. Do not apply Prefar more often than once every 12 months. To avoid crop injury rotate only to cucumbers, peppers, cole crops, carrots, lettuce or tomatoes.

Postemergence

Poast (184 g/L)

Controls several grassy weeds (Table 1).

Apply:

Weed	Rate L/acre with Assist	Rate L/acre with Merge
green or yellow foxtail, barnyard grass, proso millet witchgrass and volunteer corn	0.324 - 0.405	0.324 - 0.405
wild oats	0.57 - 0.65	0.57 - 0.65
volunteer wheat and oats	0.65	0.57 - 0.65
volunteer barley	0.65 - 0.77	0.57 - 0.65
quackgrass suppression	1.78	1.10

Where a rate range is specified for a weed, use the higher rate to control heavy infestations. Apply Poast in 25 to 45 L/acre of water with Assit Oil Concentrate or Merge at 1 L/100 L spray solution. The use of Merge will provide more consistent annual grass control than Assist. Apply with stainless steel 80° flat fan nozzles and use a minimum pressure of 240 kPa (35 psi). If weed infestation or crop canopy is dense, use 80 L/acre of water and 300 kPa (45 psi) nozzle pressures. Apply when the majority of annual grassy weeds are in the 2 to 5 leaf stage. Control may be reduced if grasses are not actively growing due to drought, flooding or prolonged cool periods (15° C or less). Do not use flood jet or hollow cone nozzles. Do not harvest within 30 days of treatment.

For suppression of quackgrass ensure that quackgrass rhizomes are thoroughly fragmented by spring tillage prior to seeding. Apply Poast with Assist or Merge at the 1 to 3 leaf stage of the weed in 45 to 60 L/acre of water with Assist Oil Concentrate or Merge at 2L/100L spray solution. Control will be enhanced by inter-row cultivation but do not cultivate sooner than 7 days after application. Do not tank mix with other herbicides. Allow at least 4 days between application of Poast and application of other herbicides. Do not seed cereals, forage grasses, corn or other susceptible crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to re-seeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields, in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Poast & Power Pack

Controls volunteer cereals at reduced rates of Poast. Also controls annual grasses including green and yellow foxtail, barnyard grass and wild oats. Apply 0.57 L/acre Poast with 1.62 L/acre Ammonium Sulphate and Assist Oil Concentrate at 1 L/100 L spray solution. Apply when the majority of the annual grasses are in the 2 to 5 leaf stage in 25 to 45 L/acre water. For heavy infestations use 80 L/acre water. Use 80° flat fan nozzles with pressures of 275 to 300 kPa (40 to 45 psi). Do not use flood jet or hollow cone nozzles. To mix, partially fill the tank with water. While the agitation runs add the Ammonium Sulphate to tank first, then add the correct amount of Poast. Lastly, add the Assist Oil Concentrate and continue filling with water. Control will be enhanced by inter-row cultivation but do not cultivate sooner than 7 days after application. Control may be reduced if grasses are stressed due to prolonged cool conditions (15° C or less), flooding or drought.

Do not mix broadleaf weed herbicides with Poast when using the Power Pack. Allow at least 4 days between application of Poast Power Pack and application of broadleaf weed herbicides. Do not seed cereals, forage grasses, corn or other sensitive crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to re-seeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Ammonium Sulphate is corrosive to metal. Thoroughly clean the sprayer after using Poast & Power Pack. Do not let this mixture stand in the tank for lengthy periods.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields, in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Storage

Cucumbers should be stored at 7 ° to 10 °C and 95 per cent relative humidity. A storage life of seven to 10 days can be expected. Cucumbers are sensitive to chilling injury at temperatures below 7° C. Avoiding moisture loss is important.

Disease Control

Bacterial Wilt

Control the cucumber beetles which transmit the disease (see cucumber beetles).

Seed Decay and Damping Off

Treat seed (if not already treated by seed company) with one of captan, or thiram seed treatment fungicides.

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Havest
Angular leaf spot (Follow 3-year crop rotation)	Kocide 101	1.376 kg	Destroy vines after harvest	1
	Fixed Copper 50W	1.821 kg		1
	Coppercide 50W	0.911-1.315 kg		1
	Fixed Copper 53	1.214 kg		1
	Tri-Basic Copper Sulfate	1.012-1.214 kg		1
	Copper oxychloride 50	1.619 kg		1
Powdery Mildew	Benlate 50W plus Manzate 200	0.223-0.344 kg 0.911-1.315 kg	Use disease free seed and spray every 10 days	5
	Bravo 500	1.942 L		1
	Bravo W-75	1.315 kg		1
	Folpan 50WP	0.809-1.619 kg		1
	Phaltan 75W	0.506-1.113 kg		1
Scab	Bravo 500	1.942 L	Use disease free seed and spray every 10 days	1
	Bravo W-75	1.315 kg		1
	Fixed Copper 53	1.214 kg		1
	Tri-Basic Copper Sulfate	1.012-1.214 kg		1
	Benlate plus Manzate 200	0.223-0.344kg 0.911-1.315 kg		5
Anthracnose	Bravo W-75	1.315 kg		1
	Bravo 500	1.942 L		1
	Maneb 80W	0.911 - 1.315 kg		5
	Manzate 200	0.911 - 1.315 kg		5
	Manzate D	0.445 - 1.315 kg		5
	Dithane M22	0.445 - 1.315 kg		5
	Fixed Copper 53	1.214 kg		1
	Tri-Basic Copper Sulfate	1.012 - 1.214 kg		1
	Fixed Copper 50W	1.821 kg		1
	Copper oxychloride 50	1.619 kg		1
	Folpan 50 WP	0.809 - 1.619 kg		1
	Phaltan 75W	0.506 - 1.113 kg		1
	Zineb 80W	0.708 - 1.133 kg		5
	Ziram 85W	0.506 - 0.809 kg		1
Alternaria, Septoria,& fungal leaf spots	Maneb 80W	0.445 - 1.315 kg		5
	Dithane M22	0.445 - 1.315 kg		5
	Fixed copper 50W	1.821 kg		1
	Copper oxychloride 50	1.619 kg		1
	Zineb 80W	0.708 - 1.133 kg		5
	Ziram 85W	0.506 - 0.809 kg		1

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Aphids	Malathion 500 EC	0.567 - 1.214 L		3
	Thiodan 4E	0.566 L		2
Cucumber beetles	Diazinon 500 EC	0.910 L	For use on cucumber & squash only. Spray when plants are breaking through and at weekly intervals.	7
	Guthion SC	0.931 L	(For use on cucumber and pumpkin only)	6
	Rotenone D	12.14 - 16.19 kg		1
	Malathion 500 EC	0.810 L		3
	Sevin XLR	1.012 L	To avoid injury on tender foliage, do not apply when foliage is wet or when rain or excessive humidity is expected within 2 days.	3
	Thiodan 4E	0.566 L		2

Eggplant

Varieties

Black Magic.

Seed Treatment

Use hot water-treated seed and dust with thiram or captan seed protectant before planting. Apply 5 ml seed protectant/ 454 g seed (1 teaspoon/lb.).

Transplants

Eggplants are a long season crop and must be started indoors. Seed is sown 8 to 10 weeks before field planting. Seeds germinate best at 26° to 29°C in sterilized soil. Care should be taken not to chill plants at any stage of development. About 280 g of seed produces transplants for 1 hectare (4 ounces for 1 acre).

Spacing

Set plants 45 to 60 cm (1 1/2 to 2 ft.) apart in rows 81 to 91 cm (2 1/2 to 3 ft.) apart.

Irrigation

Eggplants are a rank growing crop needing ample moisture at all times.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 for individual recommendations based on a soil test analysis.

As a general recommendation, broadcast and incorporate 40 to 80 kg/ha (36 to 71 lb./acre) of nitrogen and 150 to 180 kg/ha (134 to 161 lb./acre) phosphorus (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended on well drained soils. For information on the application of different forms of sulphate sulphur fertilizer, see page 13.

See **Peppers** for use of starter solution.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Use shallow cultivation. There are no recommended chemicals for eggplant.

Disease Control

Damp-Off

Treat seed (if not already treated) with captan or thiram.

Verticillium Wilt

Follow crop rotation of three to four years between successive crops of eggplant. Avoid tomatoes, peppers, sunflowers, alfalfa, sweet clover and potatoes which are also susceptible.

Harvesting & Storage

Fruit may be harvested at any time after reaching a sufficient size. It should be taken from the plant before the flesh becomes tough and the seeds begin to harden. The fruit is generally harvested when half grown, and used in its immature stage. Eggplant is subject to chilling if stored at temperatures below 4°C. Optimum temperatures for storage are 7° to 10°C.

Disease Control

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Early Blight	Maneb 80W	0.708-0.911kg	Apply when first fruit	5
	Manzate D	0.708-0.911kg	clusters are well formed.	5
	Tri-basic copper sulfate	1.619 kg	Spray every 7 to14 days depending on weather conditions.	1
	Zineb 80W	0.445-1.335 kg		5

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Aphids	Di-syston 15G & LC	see label		90
	Malathion 500EC	0.445-1.133L		3
	Thiodan 4EC	0.566 L		2
Colorado potato beetle	Sevin XLR	0.506 L		1
	Thiodan 4EC	0.506 L		2
Flea beetle	Di-syston 15G & LC	see label		90
	Malathion 500EC	0.708 - 1.012 L		3
	Sevin XLR	0.506 L		1
	Thiodan 4EC	0.567 L		2

Lettuce

Varieties

Leaf

Slobolt; Grand Rapids; Salad Bowl; Prizehead.

Crisphead or Iceberg

Ithaca; Salinas.

Butterhead

Buttercrunch; Summer Bibb.

Romaine or Cos

Parris Island; Valmaine; Romance.

Plant Characteristics

Lettuce is a cool weather crop and produces best at 15° to 18°C. Best results have been obtained from early transplant crops and late crops grown from seed. Early May transplanting is recommended for the spring crop because plants, if properly conditioned, withstand temperatures as low as -6°C.

Planting

Transplants

Start in a greenhouse 6 to 8 weeks before field planting; 280 g of seed produces sufficient transplants for 1 hectare (4 ounces for 1 acre) if sown thinly in flats. Transplant seedlings into flats at 5 cm (2 in.) spacings. Thoroughly soak flats with a starter solution of 10-52-17 before transplanting to the field.

Direct Seeding

Leaf lettuce may be sown from the time the ground is ready in the spring until the latter part of August. Iceberg varieties (head lettuce) require 8 to 10 weeks from seed to harvest, and six weeks from plants. Rate of seeding is 1.6 kg to 2.2 kg/ha (1 1/2 to 2 lb./per acre) seed.

Spacing

Leaf and Butterhead varieties: 20 to 30 cm (8 to 12 in.) between plants, 30 cm (12 in.) between rows. Head lettuce: 35 to 45 cm (14 to 18 in.) between plants and 40 cm (16 in.) between rows. Plants should be thinned when two or three leaves have formed.

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 for individual recommendations based on a soil test analysis.

As a general recommendation, broadcast and incorporate 60 to 100 kg/ha (54 to 89 lb./acre) of nitrogen and 120 to 160 kg/ha (107 to 143 lb./acre) phosphate (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. On well drained soils an application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended. For information on the application of different forms of sulphur fertilizer, see page 13.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

There are no recommended herbicides for lettuce.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Leafhoppers	Cygon 480EC	0.283 L		7
	Diazinon 500EC	0.445L		10
	Di-syston 15G & LC	See Label		Apply at Planting
	Malathion 500EC	0.708-1.012L		14
	Sevin XLR	0.506-1.012 L		14
	Thimet 15G	2.934 kg	Apply in the fertilizer band on one or both sides of the row at seeding time, or when transplants are set into the field.	

Disease Control

Disease, Culture Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Downy mildew	Maneb 80W	0.911 - 1.325 kg		7
	Manzate D	0.911 - 1.325 kg		7
	Zineb 80W	0.688 - 1.113 kg		10

Damping-Off

Treat seed with thiram.

Aster Yellows

Destroy perennial weeds around the headlands early in spring. Spray or dust the crop with Malathion 50EC at 2.2 L/ha (32 fluid ounces/acre) twice weekly beginning with emergence or transplanting to control leafhoppers which carry and transmit the disease; or apply Thimet 10G (phorate) at 11.2 kg/ha (10 lb./acre) in the fertilizer band on one or both sides of the row at seeding time, or when transplants are set in the field. Thimet is not effective for the entire crop period necessitating follow-up spray application. See label for cautions.

Physiological Breakdown

Head lettuce breakdown occurs very frequently following warm rain as the crop is reaching maturity. Having the crop mature during the cooler part of the season helps prevent this condition.

Bacterial Slime Rot

A bacterial rot often accompanies the physiological breakdown of lettuce heads. Avoid overcrowding and overwatering.

Harvest promptly when mature and pre-cool to 1°C immediately.

Fungal Rots (*Botrytis sp., Rhizoctonia solani and Sclerotinia sclerotiorum*).

Turn under crop refuse promptly after harvest. Avoid poorly drained fields and overcrowded planting. Discard heads with any trace of infection at harvest. Pre-cool to 1°C immediately after harvest. Follow a three year crop rotation avoiding beans, peas, carrots, cucumbers, squash, tomatoes and cole crops. For a list of field crops susceptible to sclerotinia disease see the current Field Crop Production Guide for Manitoba published by Manitoba Agriculture.

Muskmelon and Watermelon

Varieties

Muskmelon

Earlisweet; Sweet and Early; Gold Star; Burpee Hybrid; Sweetheart; BUX 5-74 (green flesh).

Watermelon

Stokes Sugar Hybrid; Northern Delight; Sugar Delicata; Sugar Belle.

Planting Melons

The use of transplants is recommended. Four week old plants grown in peat pots should be set out after the danger of frost is past. The plants should be planted through a clear or white-shaded plastic mulch or under plastic tunnels for optimum growth.

Plant Spacing

Muskmelon

2.1 m (7 ft.)between rows and 0.6m(2 ft.) between plants.

Watermelon

2.4 m (8 ft.) between rows & 0.9 m (3 ft.) between plants.

Fertilizer, Irrigation, Disease Control

Same as for Cucumbers.

Weed Control

Stale Seedbed

See Weed Control - Stale Seedbed, page 11.

Preplant Incorporated

Alanap (240g/L)

Controls several germinating annual weeds (Table 1). apply 4.445 to 12.15 L/acre as a preemergence spray to melons in 100 to 120 L water/acre up to 48 hours after planting. Soil clods should be thoroughly broken up and pulverized to give a smooth surface and the soil should not be disturbed unless later weed growth makes cultivation necessary. Thorough, uniform coverage of the soil surface is necessary. Do not apply during wet, cold weather as stunting of the crop may result. Alanap may be applied to melons as a postemergence spray about one month after the preemergence spray when the crop has emerged, but before the weeds are up. Do not apply during cold, wet weather as stunting of the crop may result. Use lower rates on light soil, higher rates on heavy soil. Good soil moisture is required to activate the herbicide.

Harvesting and Storage

Muskmelon

Fruit is ripe when vine is easily pulled (slipped) from the fruit. If marketing through the wholesale-retail system, fruit should be picked a few days before fully ripe. Rapid removal of field heat improves shelf life and marketing should be done immediately after harvest. Short-term storage can be done at temperatures near 10°C.

Watermelon

Experience is needed to determine when certain cultivars are ripe. A dull, hollow sound when rapped and a yellow ground spot usually indicate ripeness. Fruit must be cut off the vine, leaving a short stem attached. Fruit can be stored for a few weeks at 10°C and will continue ripening after harvest at temperatures of 12 to 18°C.

Disease Control (Melons)

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Angular Leaf Spot	Fixed Copper 50W	1.821 kg		1
	Fixed Copper 53	1.214 kg		1
	Copper Oxychloride 50	1.619 kg		1
	Tri-Basic Copper Sulfate	1.012 - 1.214 kg		1
Anthracnose	Fixed Copper 50W	1.821 kg		1
	Fixed Copper 53	1.214 kg		1
	Copper Oxychloride 50	1.619 kg		1
	Tri-Basic Copper Sulfate	1.012 - 1.214 kg		1
	Benlate plus Manzate 200	223 - 344 gm 1.012 - 1.315 kg		5
	Bravo 500	1.942 L	For cantaloupe muskmelon and honeydew only	1
		1.295 L	For watermelon only	1
	Bravo W75	1.416 kg	For cantaloupe, muskmelon and honeydew only	1
		1.315 kg	For watermelon only	1

Disease Control (melons) cont...

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Anthracnose cont...				
	Folpan 50	0.809 - 1.619 kg		1
	Phaltan 75W	0.506 - 1.113 kg		1
	Maneb 80W	0.911 - 1.315 kg		5
	Manzate D	0.445 - 1.315 kg		5
	Dithane M22	0.445 - 1.315 kg		5
	Zineb 80W	0.708 - 1.133 kg		1
	Ziram 85W	0.506 - 0.809 kg		1
Bacterial Wilt	Fixed copper 50W	1.821 kg		1
	Copper oxychloride 50	1.619 kg		1
Downy Mildew	Fixed copper 50W	1.821 kg		1
	Fixed copper 53	1.214 kg		1
	Copper oxychloride 50	1.619 kg		1
	Tri-Basic copper sulfate	1.012-1.214 kg		1
	Benlate plus	223 - 344 gm		5
	Manzate 200	1.012 - 1.315 kg		
	Folpan 50	0.809 - 1.619 kg		1
	Phaltan 75W	0.506 - 1.113 kg		1
	Maneb 80W	0.911 - 1.315 kg		5
	Manzate D	0.445 - 1.315 kg		5
	Dithane M22	0.445 - 1.315 kg		5
	Zineb 80W	0.708 - 1.133 kg		1
Alternaria, Septoria & other fungal leaf spots	Fixed copper 50W	1.821 kg		1
	Copper oxychloride 50	1.619 kg		1
	Benlate plus	223 - 344 gm		5
	Manzate 200	1.012 - 1.315 kg		
	Maneb 80W	0.911 - 1.315 kg		5
	Manzate D	0.445 - 1.315 kg		5
	Dithane M22	0.445 - 1.315 kg		5
	Zineb 80W	0.708 - 1.133 kg		1
	Ziram 85W	0.506 - 0.809 kg		1
Powdery Mildew	Benlate plus	223 - 344 gm		5
	Manzate 200	1.012-1.315 kg		
	Bravo 500	1.942 L	For cantaloupe, muskmelon and honeydew only	1
	Bravo W75	1.416 kg	For cantaloupe, muskmelon and honeydew only	1
	Folpan 50	0.809-1.619 kg		1
	Phaltan 75W	0.506-1.113 kg		1
Scab	Fixed copper 53	1.214 kg		1
	Tri-Basic copper sulfate	1.012-1.214 kg		1
	Benlate plus	223 - 344 gm		1
	Manzate 200	1.012 - 1.314 kg		
	Bravo 500	1.942 L		1
	Bravo W75	1.416 kg	For cantaloupe, muskmelon and honeydew only	1
		1.315 kg	For watermelon only	1

Onions

Varieties

Transplants (Spanish Types)
Riverside; Bullring; Valdez; Monarch; Ringmaker; Chiefton; Winner.

Cooking (seeded)
Canada Maple; Flame; Sentinel; Sweet Sandwich; Russet.

Sets
Ebenezer (yellow or white); Stuttgarter.

Pickling
Perla Prima; Aviv; Crystalwax.

Bunching
Perfecto Blanco; White Lisbon; He-Shi-Ko.

Seeding

Date

As early as land can be prepared.

Spacing

Rows 35 to 45 cm (14 to 18 in.) apart, depending on equipment for cultivation.

Seeding

Dry Onions: 2.2 to 2.9 kg/ha (2 to 2 1/2 lb./acre).

Pickling: 22 to 28 kg/ha (20 to 25 lb./acre).

Sets: 50 to 78 kg/ha (45 to 70 lb./acre).

Depth: Plant seeds 1.3 to 1.9 cm (1/2 to 3/4 in.) deep.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 for individual recommendations based on a soil test analysis.

Dry Onions

As a general recommendation, broadcast and incorporate 40 to 80 kg/ha (36 to 71 lb./acre) of nitrogen and 120 to 160 kg/ha (107 to 143 lb./acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. On well drained soils an application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended. For information on the application of different forms of sulphur fertilizer, see page 13.

Sets and Pickling Onions

As a general recommendation, apply 20 to 50 kg/ha (18 to 45 lb./acre) of nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb./acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. On well drained soils an application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended. For information on the application of different forms of sulphur fertilizer, see page 13.

***Note:** Apply fertilizer as a sideband application or broadcast. Burning will take place if applied directly with the seed.*

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Irrigation

All types of onions are very shallow rooted and quite susceptible to drought conditions. Any setback from lack of moisture may result in early maturity of bulbs with lack of size and reduced yields. Maintaining satisfactory moisture levels is essential for maximum yields.

Weed Control

Stale Seedbed

Refer to Weed Control - Stale Seedbed, page 11.

Postemergence

Excel (90 g/L)

(Dry bulb onions only) Controls several grassy weeds (Table 1). Apply 1.01 L/acre in 45 L/acre water when the majority of annual grass weeds are in the 1 to 4 leaf stage (Do not apply if total leaves including tillers exceeds 6) and when volunteer corn is 5 to 25 cm (2 to 10 in.) tall. Apply with 80° or 110° stainless steel flat fan nozzles angled 45°, and use 40 psi (275 kPa) pressure. Apply no later than 60 days prior to harvest. A time interval of 4 days before or after application of Excel is required before any other herbicide is applied. Do not apply if rain is expected within 3 hours of application. Do not apply by aircraft. Application in periods of stress will significantly reduce weed control. Reduced weed control is especially likely during periods of prolonged cool (12°C or cooler) or excessively hot (28°C or higher) daytime temperatures or low humidity.

***Weed Resistance Note:** Excel-resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide To Chemical Weed Control for further information.*

Fusilade (250 g/L) Fusilade II (125 g/L)

Controls several grassy weeds (Table 1). Apply the rate appropriate for the the weeds to be controlled according to the following table:

Weed	Leaf Stage	Rate (L/acre)
volunteer corn	2-5	0.243
barnyard grass, volunteer wheat, volunteer barley	2-4	0.324
wild oats, proso millet	2-4	0.405
green and yellow foxtail	2-4	0.57
quackgrass suppression	3-5	0.81

Apply at the recommended leaf stage in 45 to 120 L/acre of water using flat fan nozzles and a pressure of 30 to 40 psi (200 to 275 kPa). If using Fusilade (250 g/L), add Agral 90 at a rate of 0.1 L per 100 L of spray solution. Do not add Agral 90 to Fusilade II (125 g/L). Do not apply after tillering of annual grass weeds. For quackgrass suppression in annual crops ensure that rhizomes are thoroughly fragmented by spring tillage prior to seeding. Quackgrass plants more than 20 cm (8 in.) in height or which have reached the heading stage will not be controlled. Fusilade effectiveness will be reduced when plants are stressed by lack of moisture, excess moisture, flooding, low temperatures or very low relative humidity. Do not apply if rainfall is expected within 2 hours of application. Do not tank mix with other herbicides or fertilizers. Other herbicides must be applied at least 3 days after Fusilade or Fusilade II. Do not reseed sensitive crops within 60 days of application. Avoid drift onto sensitive crops (corn, cereals, forage grasses and turf). Do not apply by air.

A repeat application of the 0.405 L/acre rate may be applied if required but not less than 42 days before harvest.

Do not apply the 0.405 L/acre rate within 42 days of harvest or the 0.81 L/acre rate within 60 days of harvest.

Experimental feeding studies have demonstrated that the active ingredient in the product can produce birth defects and other adverse effects in the developing fetus of rats. Women capable of bearing children should be particularly careful when handling this product. Occupational exposure to this product will be reduced by strict adherence to the handling precautions and use directions provided on the product label.

Weed Resistance Note: *Fusilade/Fusilade II - resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Goal (192 g/L)

Controls several broadleaf weeds (Table 1). Use in dry bulb onions only. Apply 0.253 L/acre in at least 200 L/acre water at a nozzle pressure of 40 psi (275 kPa). Apply when the weeds are in the 2 to 4 leaf stage and actively growing. The first application can be made when the onions have 2 fully developed true leaves. More than one application may be necessary to control later germinating weeds. Do not apply in excess of 1.01 L/acre in one year. Do not apply Goal when the crop or weeds are under stress from excess or lack of moisture, extreme temperatures or injury from a previously applied herbicide. Do not apply within 56 days of harvest. Do not apply pre-emergent or prior to the 2 leaf stage or severe injury to the onions may occur.

Hoe-Grass 284 (284 g/L)

Dry bulb onions only. Controls wild oats, green and yellow foxtail, barnyard grass (Table 1). Apply 1.41 L/acre in at least 45 L/acre water at a nozzle pressure of 40 psi (275 kPa). Direct nozzles 45° forward. Apply when the weeds are in the 1 to 4 leaf stage and before they tiller. Other postemergence herbicides must be applied at least 4 days after Hoe-Grass 284 application. Do not apply if rain is expected within one hour. Application under hot (above 27°C) or drought conditions will result in reduced weed control. Do not apply within 60 days of harvest.

Weed Resistance Note: *Hoegrass 284 - resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Poast (184 g/L)

Controls several grassy weeds (Table 1).

Apply:

Weed	Rate (L/acre) With Assist	Rate (L/acre) With Merge
green or yellow foxtail, barnyard grass, proso millet, witchgrass and volunteer corn	0.324 - 0.405	0.324 - 0.405
wild oats	0.57 - 0.65	0.57 - 0.65
volunteer wheat and oats	0.65	0.57 - 0.65
volunteer barley	0.65 - 0.77	0.57 - 0.65
quackgrass suppression	1.78	1.10

Where a rate range is specified for a weed, use the higher rate to control heavy infestations.

Apply Poast with Assist Oil Concentrate or Merge at 1 L/100 L spray solution. The use of Merge will provide more consistent annual grass control than Assist. Apply in 25 to 45 L/acre water with stainless steel 80° flat fan nozzles and use 40 to 45 psi (275 to 300 kPa) pressure. Do not use flood jet or hollow cone nozzles. If weed infestation or crop canopy is dense, use 80 L/acre of water and 45 psi (300 kPa) nozzle pressure. Apply when the majority of annual grassy weeds are in the 2 to 5 leaf stage. Control may be reduced if grasses are not actively growing due to drought, flooding or prolonged cool periods (15°C or less).

For suppression of quackgrass, rhizomes should be thoroughly fragmented by spring tillage prior to seeding. Apply Poast at the 1 to 3 leaf stage of the quackgrass in 45 to 80 L/acre of water with Assist or Merge at 2 L/100 L spray solution. Control will be enhanced by inter-row cultivation but do not cultivate sooner than 7 days after application. Poor results will occur if the quackgrass is not actively growing at the time of treatment. Apply no later than 50 days prior to harvest. Allow at least 4 days between application of Poast and application of other pesticides. Do not seed cereals, forage grasses, corn or other sensitive crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a depth of 10 cm (4 in.) is required 7 days prior to re-seeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Poast + Power Pack

Controls volunteer cereals at reduced rates of Poast as well as annual grassy weeds including green and yellow foxtail, barnyard grass and wild oats (Table 1). Apply 0.57 L/acre Poast with 1.62 L/acre Ammonium Sulphate and Assist Oil Concentrate at 1 L/100 L spray solution in 25 to 45 L/acre water when the majority of the annual grasses are in the 2 to 5 leaf stage. For heavy infestations use 45 to 80 L/acre water. To mix, partially fill the tank with water. While agitating, add the Ammonium Sulphate to the tank, then add the correct amount of Poast. Lastly, add the Assist and continue filling with water. Use 80° flat fan nozzles and pressures of 40 to 45 psi (275 to 300 kPa). Do not use flood jet or hollow cone nozzles. Reduced control may occur if grasses are stressed due to flooding, drought or prolonged cool conditions (15°C or lower).

Apply no later than 50 days prior to harvest. Allow at least 4 days between application of Poast and other pesticides. Do not seed cereals, forage grasses, corn or other sensitive crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to reseeding Poast treated fields to grass crops (such as corn, cereals, or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Ammonium Sulphate is corrosive to metal. Thoroughly clean the sprayer after use of Poast + Power Pack. Do not let this mixture stand in the tank for lengthy periods of time.

Disease Control

Storage Neck Rot

Once the tops have been removed, dry rapidly with forced air at 35°C for the first week. The air temperature may then be reduced to 26°C until onions are well cured.

Smut

Use the seed protectant fungicide, Pro-Gro (carbathiin + thiram) at 57 g/2.270 kg (2 oz./5 lb.) seed. First moisten seed with Methocel sticker solution by mixing 29 ml Methocel per 580 ml hot water (1 oz./pint). Allow to stand overnight at room temperature. Add the Methocel solution to 454 grams (1 oz./lb.) onion seed and mix thoroughly.

Seedling Blight, Seed Decay

Apply Thiram 75 WP at 65 to 80 g/25 kg seed (4-5 oz./10 lb. seed) or Captan 75 at 1 kg/kg seed (pelleted seed only).

Sprout Inhibition

Apply maleic hydrazide (Royal MH 60 SG) at rates recommended by the manufacturer. Apply to healthy plants when 50% of the tops are down.

Disease Control

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Downy Mildew	Manzate D	0.911 kg	This disease develops in humid weather or when rain and heavy dews occur frequently. Begin spraying in mid-June and spray every 7-10 days.	10
	Dithane M-45	0.911-1.315 kg		10
	Manzate 200	0.911 - 1.315 kg		10
	Dithane M22	0.911 kg		10
	Maneb 80W	0.445 - 1.315 kg		10
	Copper oxychloride 50	1.214 kg		1
	Zineb 80W	0.344 - 1.335 kg		7
Botrytis Leaf Blight, Purple Blotch and Botrytis Blast	Dyrene 50 WP	0.911 kg	These diseases develop in humid weather or when rain and heavy dews occur frequently, Begin Spraying in mid June and spray every 7-10 days	7
	Dithane M-45	0.911 - 1.315 kg		10
	Manzate 200	0.911 - 1.315 kg		10
	Dithane M22	0.911 kg		10
	Manzate D	0.911 kg		10
	Maneb 80W	0.445 - 1.315 kg		10
	Rovral 50 WP (dry bulb only)	0.607 kg		15
	Zineb 80W	0.344 - 1.335 kg		7

Storage

If onions are dried in the field they should be well cured before placing in storage. Provide air circulation to keep them drying during storage. If onions are cured artificially, hold the forced air temperature at 35°C for the first and second week to kill neck rot organisms. For immature (greenish) bulbs, slowly raise temperature to 32°C to avoid heat damage. Then reduce temperature to 26°C for the remainder of the curing process. When well cured, gradually reduce the storage temperature on onions as close to 0°C as possible.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Onion Maggot	Dasanit 15G (Do not use on green bunching onions)	See label		45
	Diazinon 5G (furrow treatment for cooking & Spanish onions)	See label		10
	Dyfonate 10G (Cooking & seeded Spanish onions only)	See label	For soils with 10% or more organic matter	Apply at planting
	Furadan 10G (Cooking & seeded Spanish onions only)	See label		Apply at planting
	Lorsban 15G (Dry bulb & pickling onions only)	See label		Dry bulb: 109 Pickling: 97
Onion maggot fly	Cymbush 250 EC	0.113 L	Spray when flies appear after seedlings emerge and during July	3
	Diazinon 500 EC	0.445 L		10
	Ripcord	0.71 L		3
Thrips	Malathion 500 EC	0.809 L		3

Note: *Onions left in the field after harvest are a major source of over wintering onion maggot. This is especially true following early harvest of Dutch sets and pickling onions. Prevent all regrowth. Remove where possible, or plow under immediately after harvest.*

Parsnips

Varieties

Model; All America; Guernsey.

Seeding

Seed

Avoid using seed more than two years old.

Rate

1.6 to 2.2 kg/ha (1 1/2 to 2 lb./acre).

Row Spacing

45 to 60 cm (18 to 24 in.).

Depth

1.3 to 2.5 cm (1/2 to 1 in.) depending on moisture conditions. Deep seeding reduces stand.

Plant Stand

20 to 33 plants per metre (6 to 10 per ft.).

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 16 to 60 cm (6 to 24 in.). See Tables 4 to 7 for individual recommendations based on a soil test analysis.

As a general recommendation, broadcast and incorporate 20 to 60 kg/ha (18 to 54 lb./acre) of nitrogen, and 120 to 160 kg/ha (107 to 143 lb./acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. On well drained soils an application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended. For information on the application of different forms of sulphur fertilizer, see page 13.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Pre-emergence

Afolan F (480 g/L), Linuron 400 L (400 g/L)

Controls barnyard grass, green and yellow foxtail and several broadleaf weeds (Table 1). Apply after seeding:

	Rates	
Herbicide	loam or clay soils with low organic matter	muck or clay soil with medium organic matter
Afolan F	0.53 to 0.77 L/acre	0.77 - 1.01 L/acre
Linuron 400 L	0.61 to 0.81 L/acre	0.81 - 1.11 L/acre

Do not use on sand or coarse textured soils low in organic matter (less than 3%). Plant seed at least 15 cm (0.5 in.) deep. Rainfall or irrigation is needed to carry the chemical to the root zone of germinating weeds. If unusually heavy rains follow application severe injury to parsnips may occur. Do not replant to any other crop within four months of application. If initial seeding of parsnips fails to produce a stand, the same crop may be replanted in soil treated with Afolan F or Linuron 400 L. Thoroughly rework soil before replanting. Do not retreat field with a second application of Linuron 400 L or Afolan F as crop injury may result. Do not make more than one application per season.

Postemergence

Afolan F (480 g/L)

Apply only if parsnips have not had a pre-emergence treatment of Afolan F or Linuron 400 L. Controls barnyard grass, green and yellow foxtail and several broadleaf weeds

(Table 1). Apply at 0.77 to 1.9 L/acre in 90 to 135 L/acre water. If parsnips are planted on sandy soils do not apply more than 1.01 L/acre. Do not apply with pressure greater than 40 psi (275 kPa). Spray when parsnips have two or more fully developed leaves. Use lower rates on small seedling weeds and the higher rates on larger established weeds. Apply before annual grasses exceed 5 cm (2 in.) in height and before broadleaf weeds exceed 15 cm (6 in.). During hot, dry weather, spray in the cool part of the day to avoid injury. Refer to product label for detailed mixing instructions. Use 50 mesh line strainers or screens. A pump of sufficient capacity to provide adequate volume through the bypass and/or jet agitation system must be used. This will prevent settling-out while spraying. Afolan F may be applied after Agricultural Weedkiller No.1, provided treatments are at least 24 hours apart. Agricultural Weedkiller No. 1 may be applied following Afolan F, allowing a two week interval between application of Afolan F and herbicidal oil.

Agricultural Weedkiller No. 1 (100%)

Controls barnyard grass and several broadleaf weeds (Table 1). Apply 240 to 320 L/acre as an overall treatment when crop is in the two to four leaf stage and before weeds are 10 cm (4 in.) tall. Spray in evening when humidity is high and the winds are light.

Caution: *Do not mix Agricultural Weedkiller No. 1 with other herbicides. If Afolan F is applied, wait 24 hours before applying Agricultural Weedkiller No. 1. If Agricultural Weedkiller No. 1 is applied first, wait at least two weeks before applying Afolan F.*

Disease Control

Watery Soft Rot (Sclerotinia)

Handle the crop carefully to avoid wounds. Cull during harvest if rots are present. Disinfect storage area before storage using 2% solutions of copper sulphate (for example, 1 kg/50 L or 2 lb./100 gal.) . Allow storage area to dry before storing parsnips. Follow a crop rotation of two years between successive crops. Avoid beans, lettuce, carrots, cole crops, rapeseed, peas, lentils, cucumber and celery since all are susceptible to Sclerotinia. Rotate with onions, beets, cereals or corn.

Peppers

Varieties

Sweet

Bell Types:

Lady Bell; California Wonder; Green Boy; Cadice Hybrid; Staddon's Select; Hybrid Golden Bell; Ace Hybrid; Big Bertha.

Pimento or Spanish:

Earlired; Dutch Treat; Vinedale.

Hot

Red Hot; Hungarian Yellow; Gold Spike; Early Jalapeno; Anaheim.

Transplants

Since pepper seeds germinate slowly, start plants in the greenhouse 9 to 10 weeks before they are set outdoors; 205 g of seeds produces transplants for 1 hectare (3 ounces for 1 acre). A temperature of 26° to 29°C is required to produce good germination and continued vigorous plant growth.

Plant small seedlings into flats when the first true leaves begin to grow. 5 to 6 cm (2 to 2 1/2 in.) are required between plants.

Pepper plants require some hardening before being placed in the field. To do this, reduce temperatures to 15°C and cut down the water supply. This will give resistance to wilting.

Spacing

Make rows 60 to 81 cm (2 to 2 1/2 ft.) wide and allow 38 to 45 cm (15 to 18 in.) between transplants.

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.) See tables 4 to 7 for individual recommendations based on a soil test analysis.

The shock of transplanting can be reduced by applying a starter solution such as 10-52-17 when placing the plant in the field. Mix fertilizer at the rate of 454 g/45 L (1 lb. to 10 gal.) water and apply 284 ml (10 oz.) around the roots of each plant.

As a general recommendation, broadcast and incorporate 40 to 80 kg/ha (36 to 71 lb./acre) of nitrogen and 150 to 180 kg/ha (134 to 161 lb./acre) of phosphate (P_20_5). Sand and sandy loam soils are frequently low in available potassium. On these soils broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_20). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is side-banded, above rate can be reduced by one-half. An application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended on well drained soils. For information on the application of different forms of sulphur fertilizer, see page 13.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

There are no registered herbicides for peppers.

Insect Control

Insect	Product	Product Per Acre	Comments	Days to Harvest
Aphids	Cygon 480 EC	0.283-0.405 L		3
	Diazinon 500 EC	0.202-0.445 L		5
	Di-syston 15G & LC	See label		90
	Malathion 500 EC	0.708-1.012 L		3
	Thiodan 4EC	0.566 L		2

Disease Control

Damping-Off

Grow seedlings in sterilized soil. Use Captan 50 WP after seeding. Apply 175 mL (5 tablespoons)/18 L (4 gal.) water and drench flat. Repeat the application when the first true leaves appear. Apply sufficient spray to cover plants.

Wilt

Verticillium wilt may be serious if crop rotation includes tomatoes, eggplant, sunflowers, alfalfa, sweet clover and potatoes. Follow a three to four year rotation with crops other than those mentioned.

Sunscald

This may occur whenever fruit is excessively exposed to hot sun. A yellowish-white patch appears on the side of the fruit facing the sun. A blister-like area develops which eventually becomes depressed, greyish-white with dry paperlike surface.

Disease Control

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Early & Late Blight	Manzate D	0.708 - 0.911 kg	Begin applications when first fruit clusters are well formed. Apply at 7-10 day intervals.	5
	Maneb 80W	0.708 - 0.911 kg		5
	Tri-Basic copper sulfate	1.619 kg		1
	Zineb 80W	0.445 - 1.335 kg		5
Bacterial spot	Kocide 101	0.911 - 1.315 kg	Apply at 7-14 day intervals depending on disease severity.	1
	Coppercide	0.911 - 1.315 kg		1

Harvest

Peppers may be picked as soon as they reach marketable size. Remember they wilt quickly if too immature when picked. Sweet peppers are usually picked as green fruit. If they are left on the plant, they will turn red. Hot varieties should be left until they turn red.

Storage

Sweet peppers can be stored only briefly. Desirable temperatures are 7° to 10°C and relative humidity of 85 to 90 per cent. Peppers are subject to chilling at temperatures below 7°C.

Potatoes

Varieties

Early Crop

Red: Norland.

White: Carlton, Conestoga.

Storage Crop

Red: Norland, Red Pontiac.

White: Norchip, Monona, Kennebec, Shepody.

Russet: Russet Burbank, Norgold Russet.

Yellow Flesh: Yukon Gold.

Variety Description

Carlton

An early maturing variety with white-skinned, oval, shallow-eyed tubers that size as early as Warba. Boiling quality is similar to Warba.

Conestoga

A good-yielding, early maturing variety with white-skinned, round, shallow-eyed and high specific gravity tubers. It is suitable for early chipping and early table stock sales but is somewhat susceptible to hollow heart.

Norland

A good yielding, early maturing variety with red-skinned, shallow-eyed tubers suited for early harvest and storage until mid-winter.

Kennebec

A very late maturing high-yielding variety with white-skinned, shallow-eyed tubers suitable for chipping. It is susceptible to greening.

Monona

A medium to high-yielding variety of mid-season maturity with white-skinned, oblong, shallow-eyed tubers of medium to low specific gravity that are suitable for chipping. Chips of acceptable quality can be produced after long-term storage.

Norchip

A good yielding, medium maturing variety with white-skinned, high-specific-gravity tubers. It has acceptable chipping characteristics and a short dormancy period.

Norgold Russet

A good-yielding variety of medium maturity with oblong to long uniform tubers with short dormancy period. Cooking quality is suited to baking and table stock sales but the percentage of grade-out resulting from hollow heart can be very high, making the potatoes unsaleable without the aid of mechanical hollow heart sorting equipment.

Red Pontiac

A high yielding, drought tolerant variety with red-skinned, medium deep-eyed tubers of low dry matter content. Suitable for table stock use.

Russet Burbank

A high quality, late maturing variety with russet-skinned, long, shallow-eyed tubers suitable for processing (other than chips), baking and table stock use. Its tuber shape can be extremely variable if plants are subject to stress during the tuber enlargement period of growth.

In-Row Spacing Guide with Between Row spacing of 96 cm (36 in.) for Dryland Production

Variety	Seed		Table Stock		Processing	
	cm	in.	cm.	in.	cm	in.
Carlton	23-28	9-11	28-33	11-13		
Conestoga	25-30	10-12			30-36	12-14
Kennebec	23-25	9-10			25-30	10-12
Monona	28-33	11-13			30-36	12-14
Norchip	30-33	12-13			33-36	13-14
Norgold Russet	28-33	11-13	30-36	12-14		
Norland	28-33	11-13	30-33	12-13		
Red Pontiac	25-28	10-11	25-28	10-11		
Russet Burbank	30-33	12-13	39-40	15-16	43 - 46	17-18
Shepody*	28-36	11-14			36 - 40	14 -16
Yukon Gold	28-33	11-12	30-36	12-14		

*Spacing Guide is based on limited data and field experience.

Shepody

A high quality, late mid-season maturing variety with large, white-skinned, oblong-to-elliptical tubers. Yield, specific gravity and french fry color are similar to Russet Burbank. First harvest for processing is acceptable at a minimum of 5 to 7 days earlier than Russet Burbank.

Yukon Gold

A medium-yielding, medium maturing, yellow-fleshed variety with high specific gravity and shallow-eyed tubers with acceptable table stock cooking quality. The percentage of hollow heart can frequently exceed the Canada grade tolerance levels.

Seed Handling Practices

The regular purchase of foundation or certified seed is an excellent practice to follow. Handling techniques are also important. Tubers should be cut into blocky seed pieces, 40 to 55 g (1 1/2 to 2 oz.) in size. Separate and discard chips and slivers below 28 grams (1 oz.). This reduces the number of weak plants in the field and increases yield potential.

Seed potatoes should be hauled, stored and handled with equipment that is thoroughly cleaned and disinfected. Use high pressure washers or steam for cleaning and a quaternary ammonium compound in solution under pressure for disinfecting. Use a quaternary ammonia product such as HY X or Potato Gard, and mix using 600 ml product per 160 L water (20 oz./35 gal. water) or household bleach (5% solution) at 600 ml product per 4.5 L water (20 oz. product/gal. water). Maintain a wet surface for a minimum of 10 minutes when using a disinfectant.

Where practical, warm seed potatoes prior to cutting. This results in short, thick sprouts developing. While cutting potatoes, disinfect the cutting and handling machinery. If cut seed is not being planted immediately, very specific conditions for storage must be provided. These are:

- forced air circulation through the pile.
- holding temperature of around 16°C and relative humidity of 85 to 95 per cent for at least 3 days.
- after the curing period, maintain humidity but reduce temperature. Reduce air flow by operating fans intermittently.

Seed Treatment

Proper treatment of cut seed will help assure a good stand of plants in the field.

Dry Treatment

Apply one of the following: metiram (Polyram), captan or mancozeb (Dithane M-45, Tuberseal or Manzate 200) or thiophanate methyl (Easout) according to manufacturer's directions. Application mechanism should provide a uniform coverage of dust over the surface of the cut tubers.

Wet Treatment

Less than six hours after cutting, dip pieces in Captan 50% or 75% WP at 3 kg/1000 L (3 lb./100 gal. water). Plant immediately or if necessary store in shallow piles under forced ventilation.

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 for individual recommendations based on a soil test analysis.

All fertilizer should be added as a sideband application at time of seeding for the most efficient use of the fertilizer. No more than 90 kg/ha (80 lb./acre) nitrogen in urea form should be applied as a sideband application at time of seeding. When the crop is seeded less than five days after the application of anhydrous ammonia and aqua ammonia, damage may occur particularly on sandy soils or under dry soil conditions.

Excess nutrient levels may occur when high rates of fertilizer are used and can result in decreased quality and storage characteristics. Soil testing to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels.

Seed Weight Requirements for Planting

At 96 cm Between-Row Spacing
(t/ha)

	In-Row Plant Spacing (cm)					
Seed Set Weight (g)	**20**	**25**	**30**	**35**	**40**	**45**
36	1.88	1.50	1.25	1.07	0.94	0.83
43	2.24	1.79	1.49	1.28	1.12	1.00
50	2.60	2.08	1.74	1.49	1.30	1.16
57	2.97	2.38	1.98	1.70	1.48	1.32

At 38 Inch Between-Row Spacing
(CWT/ACRE)

	In-Row Plant Spacing (In.)					
Seed Set Weight (oz.)	**8**	**10**	**12**	**14**	**16**	**18**
1 1/4	16.1	12.9	10.7	9.2	8.1	7.2
1 1/2	19.3	15.5	12.9	11.1	9.7	8.6
1 3/4	22.6	18.1	15.0	12.9	11.3	10.0
2	25.8	20.6	17.2	14.7	12.9	11.5

Producers should avoid applying fertilizers at rates in excess of those recommended by a soil test.

Weed Control

Timely tillage with harrows, mulchers and cultivators supplemented with chemical weed control can be used to effectively control most weeds in potatoes. Timing of operations and chemical control measures must be selected for specific field conditions and weed problems.

Stale Seedbed

See Stale Seedbed Weed Control at the beginning of the Horticulture section in the current *Guide to Chemical Weed Control.*

Preplant Incorporated

Dual (960 g/L)

Controls green and yellow foxtail and barnyard grass. (Table 1). Apply 0.81 to 1.11 L/acre in a minimum of 60 L/acre of water. Use the higher rate for heavy weed infestations. Incorporate in the top 5 cm (2 in.) of soil with a tandem disc, vibrating shank cultivator or harrows set to work the soil no deeper than 10 cm (4 in.). Immediate incorporation is not required. Do not use on peat or muck soils. Heavy rainfall conditions following application of Dual may result in reduced weed control, especially on sandier soil types. See Herbicide Incorporation section in the current *Guide to Chemical Weed Control* for incorporation instructions. A postemergent treatment with either Lexone or Sencor will be required for broadleaf weed control.

Eptam 8-E (800 g/L)

Controls several annual grasses and broadleaf weeds (Table 1).

Spring application

Apply 1.72 to 2.23 L/acre in at least 45 L/acre water. Eptam must be applied to the dry soil surface of a well prepared seedbed. Incorporate immediately according to instructions in the Herbicide Incorporation section of the current *Guide to Chemical Weed Control.* The level of weed control will be reduced where Eptam is used on soils which have been treated with Eradicane, Eptam or Sutan the previous growing season. It is anticipated that the reduction in control will be greater where these herbicides have been used repeatedly for two or more years.

Fall application

Although registered for fall application, the application and incorporation requirements for Eptam predispose soils to erosion and this use is not recommended.

Quackgrass control

Spring Application. Apply 2.83 to 3.44 L/acre in at least 45 L/acre water. Spray on dry soil surface. Incorporate immediately according to instructions in the Herbicide Incorporation section in the current *Guide to Chemical Weed Control.* Quackgrass must be cut up so that remaining rhizomes have 4 or less nodes prior to application.

Eptam 8-E may be applied with liquid fertilizer or on granular fertilizer. See the Herbicide Incorporation section of the current *Guide to Chemical Weed Control* for specific instructions regarding application and use on dry fertilizer.

Eptam 8-E (800 g/L) plus Lexone DF (75%) or Sencor 500 F (500 g/L), Sencor 75 DF (75%) or Sencor Solupak 75 DF (75%)

Controls annual grasses and several broadleaf weeds (Table 1). Apply a tank mix of 0.142 to 0.223 kg/acre of

General Rate of Nutrient to Add

	Nitrogen (1) (N)		Phosphate (P_2O_5)		Potash (K_2O)		Sulphur (S)	
Potatoes to be grown on	**kg/ha**	**lb./acre**	**kg/ha**	**lb./acre**	**kg/ha**	**lb./acre**	**kg/ha**	**lb./acre**
Fallow or legume breaking (2)	35-50	31-45	50-60	45-54	(3)	(3)	(4)	(4)
Grass and grass-legume breaking (2)	50-74	45-62	50-60	45-54	(3)	(3)	(4)	(4)
Stubble	70-100	62-89	50-60	45-54	(3)	(3)	(4)	(4)

(1) Rates are based on granular nitrogen applied broadcast at or near seeding time. See Nitrogen section, page 22.

(2) Refers to breaking after first cut of forage.

(3) Sands, sandy loam and organic soils are frequently low in available potassium. On these soils apply 30 to 110 kg/ha (27 to 98 lb./acre) of potash (K_2O).

(4) Twenty kg/ha (18 lb./acre) of sulphate sulphur (S) are recommended on well-drained soils. For information on the application of the different forms of sulphate sulphur fertilizer, see page 13. Sulphur deficiency may occur in many soils and in any area of the province. Because of this, a soil test is recommended to establish the available sulphur status of fields.

Lexone DF or 0.222 to 0.343 L/acre Sencor 500 F or 0.151 to 0.222 kg/acre Sencor 75 DF or Sencor Solupak 75 DF tank mixed with 1.70 to 2.23 L/acre Eptam 8-E. Do not use on red-skinned or early potatoes or on varieties Belleisle, Tobique or Shepody or on soil with greater than 7 per cent organic matter or less than 2 per cent organic matter. Refer to Herbicide Incorporation section in the current *Guide to Chemical Weed Control.*

Fall seeded cover crops such as wheat, oats and rye may be injured when seeded the same season as application of Lexone or Sencor. Rapeseed (except triazine tolerant canola), sunflowers, sugar beets and several horticulture crops may be sensitive to sencor residue the year following application. After harvest tillage practices that provide thorough mixing of the soil may be helpful in reducing the chance of injury to succeeding crops. The level of weed control will be reduced where Eptam is used on soils which have been treated with Eradicane, Eptam or Sutan the previous growing season. It is anticipated that the reduction in control will be greater where these herbicides have been used repeatedly for two or more years.

Sencor Solupak 75DF packets are water soluble and will dissolve completely in water. Open the outer bag and drop the required number of unopened inner packets in the spray tank as directed. Do not excessively handle the packets or expose them to moisture. Do not allow the packets to become wet prior to mixing spray solution. Do not handle with wet hands. Reseal outer bag to protect remaining packets. Do not use solupaks in liquid fertilizer.

Pre-emergence

Eptam 8-E (800 g/L) - drag-off

Controls several annual grasses and broadleaf weeds (Table 1). Apply 1.72 to 3.44 L/acre. The field must first be "dragged off", followed by Eptam 8-E application and incorporation. Use spike toothed harrows or cultivation equipment for incorporation. Refer to Herbicide Incorporation section in the current *Guide to Chemical Weed Control.*

Gramoxone (200 g/L)

Controls annual grasses, broadleaf weeds and top growth of perennial weeds (Table 1). Apply 1.11 to 2.22 L/acre in 120 to 445 L/acre clean water to emerged weeds. Use the higher rate when weeds are above 5 cm (2 in.) in height and the higher volume of water on dense weed growth. Do not apply if more than 30% of the potatoes have emerged. Do not apply to emerged plants in the evening, under cloudy conditions, or when plants are under moisture stress. Potatoes grown for early harvest should not be treated after emergence.

Gramoxone (200 g/L) plus Lexone DF (75%)

Controls annual grasses, broadleaf weeds and top growth of perennial weeds (Table 1). Apply a tank mix of 0.336 to 0.49 kg/acre Lexone DF plus 1.11 L/acre Gramoxone as a pre-emergence broadcast application to potatoes, after the weeds have emerged up to and including ground crack. Use the lower rate of Lexone on light soils, the higher rate on heavier and high organic matter soils. Do not apply after ground crack when tops have emerged or excessive injury may result. Fall seeded cover crops such as wheat, oats and rye may be injured when seeded the same season as application of Lexone. Rapeseed (except triazine tolerant canola), sunflowers, sugar beets and several horticulture crops may be sensitive to Lexone residue the year following application. Post-harvest tillage practices that provide thorough mixing of the soil may be helpful in reducing the chance of injury to succeeding crops.

Laredo (356 g/L), Roundup (356 g/L), Wrangler (356 g/L)

Controls annual weeds (Table 1). Apply 0.91 L/acre in at least 45 L/acre water to actively growing grasses and broadleaf weeds less than 15 cm (6 in.) tall. If weeds are over 15 cm (6 in.) tall apply 1.42 L/acre. Apply to emerged weeds before or after planting, but before potatoes show above ground. Do not apply after potato emergence as Laredo, Roundup or Wrangler will kill all green vegetation. Allow at least 3 days after treatment before disturbing the soil. Heavy rainfall within 2 hours after application may wash chemical off the foliage and a repeat treatment may be required. Rainfall within 6 hours after application may reduce effectiveness.

Refer to the Perennial Weed Control on Cropland section and the Special Weed Problems section in the current *Guide to Chemical Weed Control* for information on growth stages and rates of application for control of perennial weeds.

Postemergence

Excel (90 g/L)

Controls several annual grassy weeds (Table 1). Apply 1.01 L/acre Excel in 45 L/acre water when the majority of annual grass weeds are in the 1 to 4 leaf stage. (Do not apply if total leaves including tillers exceed 6 and when volunteer corn is 5 to 25 cm (2 to 10 in.) tall). Apply at 40 psi (275 kPa) with 80° or 110° stainless steel flat fan nozzles angled 45° forward. Apply no later than 60 days prior to harvest. A time interval of 4 days before or after application of Excel is required before any pesticide or other chemical is applied. Do not apply Excel if rain is expected within 3 hours of application. Do not apply Excel by aircraft. Application of Excel in periods of stress will significantly reduce weed control. Reduced weed control is especially likely during periods of prolonged cold (12°C or cooler) or excessively hot (28°C or greater) day time temperature or low humidity.

Weed Resistance Note: *Excel-resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Eptam 8-E (800 g/L) Sprinkler Irrigation

Controls annual grasses and several broadleaf weeds (Table 1). Meter 1.72 to 2.22 L/acre into first irrigation water following a clean cultivation. Do not apply within 45 days of harvest.

Fusilade (250 g/L), Fusilade II (125 g/L)

Controls several grassy weeds (Table 1). Apply the rate appropriate for the weeds to be controlled according to the following table:

Weed	**Leaf Stage**	**Rate (L/acre)**
volunteer corn	2-5	0.243
barnyard grass, volunteer wheat, volunteer barley	2-4	0.324
wild oats, proso millet	2-4	0.405
green and yellow foxtail	2-4	0.57
quackgrass suppression	3-5	0.81

Apply at the recommended leaf stage in 45 to 120 L/acre of water using flat fan nozzles and a pressure of 30 to 40 psi (200 to 275 kPa). If using Fusilade (250 g/L), add Agral 90 at a rate of 0.1 L per 100 L of spray solution. Do not add Agral 90 to Fusilade II (125 g/L). Do not apply after tillering of annual grass weeds. For quackgrass suppression in annual crops ensure that rhizomes are thoroughly fragmented by tillage in the spring prior to application. Quackgrass plants more than 20 cm (8 in.) in height or which have reached the heading stage will not be controlled. Fusilade or Fusilade II effectiveness will be reduced when plants are stressed by lack of moisture, excess moisture, flooding, low temperatures or very low relative humidity. Do not apply if rainfall is expected within 2 hours of application. Do not tank mix with other herbicides or fertilizers. Other herbicides must be applied at least 3 days after Fusilade or Fusilade II. Do not reseed sensitive crops within 60 days of application. Avoid drift onto sensitive crops (corn, cereals, forage grasses and turf). Do not graze or feed treated crops during the year of treatment. Do not apply by air. Do not apply within 90 days of harvest.

Experimental feeding studies have demonstrated that the active ingredient in this product can produce birth defects and other adverse effects in the developing fetus of rats. Women capable of bearing children should be particularly careful when handling this product. Occupational exposure to this product will be reduced by strict adherence to the handling procautions and use directions provided on the product label.

Hoe-Grass 284 (284 g/L)

Controls wild oats, green and yellow foxtail, barnyard grass (Table 1). Apply 1.42 L/acre in at least 45 L/acre water at a nozzle pressure of 40 psi (275 kPa). Direct nozzles 45° forward. Apply when weeds are in the 1 to 4 leaf stage, and before they tiller. Other postemergent herbicides must be applied at least 4 days after Hoe-Grass 284 application. Do not apply if rain is expected within 1 hour. Application under hot (above 27°C) or drought conditions will result in reduced weed control. Do not apply within 60 days of harvest.

Weed Resistance Note: *Hoegrass 284 - resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Lexone DF (75%), Lexone L (480 g/L)

Controls several broadleaf weeds (Table 1). Apply 0.222 L/acre Lexone L or 0.141 kg/acre Lexone DF in 45 to 120 L/acre water. Apply early postemergence soon after potatoes emerge and before weeds are 4 cm (1.6 in.) in height. Do not use on red-skinned or early maturing potatoes or on varieties Shepody, Belleisle, Tobique. Do not apply within 60 days of harvest.

Poast (184 g/L)

Controls several grassy weeds. Apply:

Weed	Rate (L/acre) with Assist	Rate (L/acre) with Merge
green or yellow foxtail, barnyard grass, proso millet, witchgrass and volunteer corn	0.324 - 0.405	0.324 - 0.405
wild oats	0.57 - 0.65	0.57 - 0.65
volunteer wheat and oats	0.65	0.57 - 0.65
volunteer barley	0.65 - 0.77	0.57 - 0.65
quackgrass suppression	1.78	1.10

Where a rate range is specified for a weed, use the higher rate to control heavy infestations. Apply Poast with Assist Oil Concentrate or Merge at 1 L/100 L spray solution in 25 to 45 L/acre water. The use of Merge will provide more consistent annual grass control than Assist. Apply with stainless steel 80° flat fan nozzles and use 40 to 45 psi (275 to 300 kPa) pressure. If weed infestations or crop canopy is dense, use 45 to 80 L/acre of water and 45 psi (300 kPa) pressure. Apply when the majority of annual grassy weeds are in the 2 to 5 leaf stage. Control may be reduced if grasses are not actively growing due to drought, flooding or prolonged cool periods (15°C or less). Do not use flood jet or hollow cone nozzles. Apply no later than 80 days prior to harvest. For aerial recommendations see Aerial Application section in the current *Guide to Guide to Chemical Weed Control*. Allow 4 days between application of Poast and any other chemicals. For suppression of quackgrass, rhizomes must be thoroughly fragmented by spring tillage prior to seeding. Apply Poast at the 1 to 3 leaf stage of the quackgrass in 45 to 80 L/acre water with Assist Oil Concentrate or Merge at 2 L/100 L spray solution. Control will be enhanced by inter-row cultivation but do not cultivate sooner than 7 days after application. Poor results will occur if the quackgrass is not actively growing at the time of treatment. Do not seed cereals, forage grasses, corn or other sensitive crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to reseeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields, in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Poast + Power Pack

Controls volunteer cereals and suppresses top growth of quackgrass, at reduced rates of Poast. For annual grass control, apply when the majority of weeds are in the 2 to 5 leaf stage. Apply 0.57 L/acre Poast with 1.62 L/acre Ammonium Sulphate and Assist Oil Concentrate at 1 L/100 L spray solution in 25 to 45 L/acre water. For heavy infestations or if the crop canopy is heavy, use Assist Oil Concentrate at 2 L/100 L spray solution in 80 L/acre water. To mix, partially fill the tank with water. While agitating, add the Ammonium Sulphate to the tank, then add the correct amount of Poast. Lastly, add the Assist Oil Concentrate and continue filling with water. For quackgrass suppression, ensure that rhizomes are thoroughly fragmented by spring tillage prior to seeding. Apply 1.1 L/acre Poast with 1.62 L/acre Ammonium Sulphate and Assist Oil Concentrate at 1 to 2 L/100 L spray solution in 45 to 60 L/acre water at the 1 to 3 leaf stage of quackgrass. Control will be enhanced by inter-row cultivation but do not cultivate sooner than 7 days after application.

Spray with 80° flat fan nozzles at pressures of 40 to 45 psi (275 to 300 kPa). Do not use flood jet or hollow cone nozzles. Control may be reduced if grasses are under stress due to drought, flooding or prolonged cool weather (15°C or less). Apply no later than 80 days prior to harvest. Allow 4 days between Poast and application of any other chemicals. Do not seed cereals, forage grasses, corn or other sensitive crops into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to reseeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields, in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Ammonium Sulphate is corrosive to metal. Thoroughly clean the sprayer after use of Poast plus Power Pack. Do not let mixture stand in the tank for lengthy periods of time.

Sencor 500F (500 g/L), Sencor 75DF (75%), Sencor Solupak 75DF (75%)

Controls several broadleaf weeds (Table 1). Apply 0.222 L/acre Sencor 500F or 0.151 kg/acre Sencor 75DF or Sencor Solupak 75DF in 45 to 120 L/acre water. Apply early postemergence soon after potatoes emerge and before weeds are 4 cm (1.6 in.) high. Do not use on the varieties Shepody, Belleisle and Tobique. Do not use postemergence treatments on red skinned or on early maturing varieties. Do not apply within 60 days of harvest.

Sencor Solupak 75DF packets are water soluble and will dissolve completely in water. Open the outer bag and drop the required number of unopened inner packets in the spray tank as directed. Do not excessively handle the packets or expose them to moisture. Do not allow the packets to become wet prior to mixing spray solution. Do not handle with wet hands. Reseal outer bag to protect remaining packets. Do not use solupaks in liquid fertilizer.

Disease Control

Practice crop rotations to prevent buildup in the soil of organisms that cause scab, blackleg, Rhizoctonia and wilts. Avoid sunflowers, flax and rapeseed in the rotation. The plow down of a green cover crop of oats reduces rhizoctonia in the soil. Seed piece treatment reduces the risk of introducing diseases into a new field. For Verticillium wilt control treat seed pieces with thiophanate methyl (Easout). A crop rotation of four to five years is recommended. If a shorter rotation is being followed avoid sunflowers, sweet clover, tomatoes, peppers, eggplant and alfalfa which are susceptible to verticillium wilt. Rotate with cereals.

Sanitation of all potato storage, handling and hauling equipment and disposal of all used bags is essential for bacterial ring rot control. Disinfect storage facilities and equipment with a quaternary ammonia product or household bleach, 5% solution at 700 ml/5L (20 oz/gal.) water. Use high pressure washers or a steam cleaning unit to clean equipment before moving between fields, particularly for seed potatoes. Maintain a wet surface during disinfection for a minimum of 10 minutes.

Dispose of culls carefully to prevent growth of plants. This helps to avoid contamination of the upcoming crop with bacterial ring rot or late blight. Care should be taken to plant potatoes in soil sufficiently warm for growth (approximately 7°C) in order to control blackleg, rhizoctonia and seed piece decay. A regular spray program will control early and late blight diseases.

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Early and Late Blight	Bravo 500	0.647 - 0.971 L	Begin applications in July when first signs of leaf spotting occurs.	1
	Dithane M22	0.708 - 0.911 kg	Repeat every 7 - 10 days.	1
	Manzate D	0.445 - 0.907 kg		1
	Dithane M45	0.911 kg		1
	Manzate 200	0.911 kg		1
	Polyram 80W	0.445 - 0.916 kg		1
	Polyram DF	0.911 kg		1
	Polyram 7D	11.13 - 13.15 kg		1
	Copper 50W	2.226 kg		1
	Bravo W-75	0.445 - 0.708 kg		1
	Maneb 80W	0.445 - 1.315 kg		1
	Fixed copper 53	2.023 kg		1
	Fixed copper 50W	1.821 kg		1
	Tri-basic copper sulfate	1.619 - 2.833 kg		1
	Copper oxychloride 50	1.619 kg		1
	Zineb 80W	0.688-1.335 kg		1

To control the storage diseases silver scurf and fusarium dry rot, avoid bruising potatoes when harvesting. Treat potatoes while going into storage with thiabendazole (Mertect). Mix 8 L/170 L water (1.9 gal/40 gal.) , then spray 2 L solution per tonne (64 oz/ton). Do not treat potatoes being exported with thiabendazole (Mertect) at the Canadian rates.

The United States rate is about one seventh of the Canadian rate. Consult current recommendations of the country to which the potatoes are being exported. Resistance to Mertect by the fungus causing Silver scurf has been reported in Alberta and may occur in Manitoba following continuous use.

Sprout Inhibition

Field Application

Apply maleic hydrazide (Royal MH60 SG) at the rates recommended by the manufacturer. This should take place about two weeks after full bloom and only when plants are actively growing and tops are green and healthy.

Storage Application

Inject chlorprophan (sprout nip, potato sprout inhibitor)as a mist or fog to the storage building after potatoes have gone through the suberization period. (These products should be applied by certified applicator.) Potatoes should be free of excessive dirt and other debris, and the storage facility should have a ventilation system that moves air through the pile. Care should be taken when treating Norchip with chlorprophan because of a short dormancy period. Treat early and do not ventilate excessively.

Grading Application

Chlorprophan (sprout nip E.C.) may be applied as a mist to tubers as they pass over the grader or through the wash line. This does not control sprouting in storage but is effective against the development of sprouts as the potatoes move through the market channels. Equipment to apply chlorprophan in this manner is not costly and the technique is suitable for growers with small or large volumes.

Vine Killing

Use one of several desiccants such as dinoseb (e.g. Dytop, Dow General Liquid with oil, etc.) or diquat (Reglone) as recommended by manufacturers. They will kill the tops of the plants and encourage earlier maturity and a higher percentage of marketable tubers. If the crop is left unharvested after top killing for 10 to 20 days, skins will set. This helps minimize skinning and bruising during harvest.

Field to Storage Transport

Hauling potatoes from field to storage when tubers are exposed to the air results in the drying of bruised and cut tissue. This dry surface prevents suberization and leaves the damaged areas open to infection and subsequent decay. Loads of potatoes should be covered with tarpaulins to protect the exposed tubers that are in transit or being held on the truck. This will increase relative humidity, thereby reducing drying and allowing suberization to take place.

For the same reason it is important to protect cut seed from drying. Unsuberized seed is subject to a greater loss by seed piece decay.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Aphids	Belmark 30EC	0.093-0.132 L		7
	Cygon 480EC	0.283-0.405 L		7
	Diazinon 500EC	0.445 L		14
	Furadan 480F	0.445 L		7
	Guthion SC	1.146 L		7
	Lannate L	0.910 L		3
	Malathion 500EC	0.566-0.809 L		3
	Monitor 480	0.708-0.910 L		14
	Thimet 15G	See label		Apply at planting
	Thiodan 4EC	0.566 L		1
Colorado potato beetle (Risk of insecticide resistance build up in C.P.B. may be reduced by applying products of different classification from year to year. Spray when leaf damage exceeds 10%).	Ambush 500EC	0.057-0.081 L		1
	Belmark 30	0.091-0.132 L		7
	Cymbush 250EC	0.057 L		7
	Decis 5EC	0.040-0.061 L	Use in 80-200 L of water	23
	Diazinon 500EC	0.445 L		14
	Di-syston 15G & LC	See label		90
	Furadan 480F	0.445 L		7
	Furadan 10G	See label		Apply at planting
	Guthion SC	0.506-0.708 L		7
	Lorsban 4E	0.405 L		7
	Malathion 500EC	0.566-0.809 L		3
	Monitor 480L	0.708-0.910 L		14
	Ripcord 400EC	0.354 L		7
	Sevin XLR	0.506 L		7
	Supracide 250EC	0.445 L	Apply in 44.5 L water	14
	Thimet 15G	See label		90
	Thiodan 4EC	0.566 L		1
Flea beetles	Ambush 500EC	0.057-0.081 L		1
	Belmark 30EC	0.057-0.081 L		7
	Cymbush 250EC	0.057 L		7
	Decis 5EC	0.040-0.061 L		23
	Diazinon 500EC	0.445 L		14
	Di-syston 15G & LC	See label		90
	Guthion SC	0.901-1.416 L		7
	Furadan 480F	0.445 L		7
	Furadan 10G	See label		90
	Lorsban 4E	0.405 L		7
	Monitor 480L	0.708-0.910 L		14
	Ripcord 400EC	0.035 L		7
	Sevin XLR	0.506 L		7
	Thimet 15G	See label		90
	Thiodan 4EC	0.566 L		1

Insect	Product	Product per Acre	Comments	Days to Harvest
Potato leafhopper (Spray when leafhopper numbers exceed 30/100 leaves).	Ambush 500EC	0.057-0.081 L		1
	Belmark 30	0.091-0.131 L		7
	Cygon 480EC	0.283-0.405 L		7
	Cymbush 250EC	0.057 L		7
	Diazinon 500EC	0.445 L		14
	Di-syston 15G & LC	See label		90
	Furadan 10G	See label		90
	Furadan 480G	0.445 L		7
	Guthion SC	0.910-1.416 L		7
	Lannate L	0.910 L		3
	Malathion 500EC	0.566-0.809 L		3
	Ripcord 400EC	0.035 L		7
	Sevin XLR	0.506 L		7
	Thimet 15G	See label		90
	Thiodan 4EC	0.566 L		1
Wireworms **Broadcast application**	Dyfonate 10G	22.66 kg	Incorporate into soil by discing or rototilling to a depth of 15 cm (6 in.) prior to planting.	
Wireworms **Furrow treatment**	Dyfonate 10G	9.106 kg	Apply into fertilizer furrows at planting.	

Leafhoppers, flea beetles, aphids and Colorado potato beetles are the major insects attacking potatoes in Manitoba. Aphids, because they transfer virus diseases, are of major concern to the seed grower.

Storage

The initial storage period is critical. Potatoes in which soft rot may develop should have initial storage temperatures of 8-10°C. Soft rot development can be expected when blackleg or frost are present. Where fusarium dry rot is present, initial storage temperatures of 10-18°C are most beneficial. Fusarium dry rot is most serious when soil conditions are dry and when tubers are injured during harvest. These conditions should be held for the first 10 to 14 days. Follow this period with a gradual drop in temperature while humidity is maintained at a minimum of 90%. Humidifiers should be operating whenever fans are running, as long as the air entering the pile is at least slightly below tuber temperature. Exceptions to this include ventilating potatoes which are damaged by fall frost or potatoes which develop the disease leak (usually results from harvesting when tuber/soil temperature is high). Under these circumstances, it may be necessary to circulate the air at a lower relative humidity (perhaps 80%) through the pile until the condition is reduced.

Mechanical Damage

The greatest single cause of loss of tubers of marketable size and type is mechanical damage. In the majority of cases, storage rot problems are a direct result of damage inflicted on the tuber during harvesting and handling. Most organisms attacking the potato cannot penetrate the unbroken skin of the tuber. However, when the tuber is cut, bruised, squashed or otherwise mechanically damaged, a wide range of soil borne organisms are able to attack the tuber causing a rotting of the tissue.

Experiments indicate that many growers lose at least 15% of the No. 1 grade potatoes they grow through mechanical injury. Prevent loss from mechanical injury by slowing down conveyors so they run full, reducing distances the tubers drop and roll, and providing adequate instruction, supervision and incentives for workers. Make sure trucks are filled in layers and piling in storage is done in steps to reduce rollback.

Good management of the harvest operation pays high dividends in reduced shrink in storage, higher percentage of No. 1 grade produce and higher net return per acre. In Idaho, it is estimated that losses from bruising cost from $70 to $80 per acre. Losses in Manitoba are also very substantial.

Bruise Detection

Catechol System

Equipment

- plastic pail
- plastic mesh bag or perforated pail to fit inside pail
- rubber gloves
- plastic funnel
- plastic jug (opaque)
- solution - 1% catechol, 99% water

Sources of Supply:

Fisher Scientific
1137 Keewatin St.
Winnipeg, Manitoba
Baxter Corporation
590 Moray St.
Winnipeg, Manitoba

Chemonics Scientific Ltd.
143 De Bets
Winnipeg, Manitoba

Method

Pour the solution into a plastic pail. Place tubers into mesh bag, immerse in catechol solution for one minute, remove, drain, and let stand for 5 to 10 minutes. After dipping samples, the solution may be stored in the plastic jug.

Results

Exposed broken tissue will turn red and later reddish brown.

Time Delay System

Damaged tissue under an unbroken skin will not develop the reddish brown color when the catechol method is used. A complete appraisal of damage may be accomplished by peeling tubers 24 to 48 hours after the injury has occurred. The damaged areas will show up as grey to black spots in the white flesh of the peeled tuber.

Special Note:

Where potatoes are being grown for a processing firm, take particular note of the company's recommendations in connection with insecticides, fungicides, top killers, sprout inhibitors and storage conditions. If company recommendations differ from those above, follow company specifications.

Radishes

Varieties

Champion; Scarlet Knight; Cherry Belle.

Seed Treatment

Dust seed with thiram or captan seed protectant at 5 ml/ 454 g (one teaspoonful /lb.) of seed.

Seeding

Sow seeds 1.3 cm (1/2 in.) deep at a rate of 11 to 16 kg/ ha (10 to 15 lb./acre); 11 to 33 kg/ha (10 to 30 lb./acre) for machine harvesting.

Radishes are resistant to several degrees of frost, so seeding may start as soon as the land is ready in the spring. Maturity is reached in 21 to 26 days or longer in cool weather. Consecutive plantings can lengthen harvest period. Radishes are grown successfully on peat land throughout the summer months. Only short to medium foliage varieties should be used.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.) See tables 4 to 7 for individual recommendations based on a soil test analysis.

As a general recommendation, broadcast and incorporate 20 to 50 kg/ha (18 to 45 lb./acre) of nitrogen, and 120 to 160 kg/ha (107 to 143 lb./acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. Application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended on well drained soils. For information on the application of different forms of sulphur fertilizer, see page 13.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

There are no recommended herbicides for radish.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Flea Beetles	Ambush 500 EC	0.056 L		2
	Diazinon 500 EC	0.445 L		10
	Malathion 500 EC	0.566 - 1.214 L		7
	Sevin XLR	0.506 - 1.012 L		7
Radish maggot	Diazinon 5G	567 g/1000 ft of row	Apply granules in furrow when planting	
	Diazinon 500EC	0.445 L	Apply as drench	10

Rutabagas (Swede Turnip)

Varieties

Laurentian.

Seeding

Dates

Early Market: Plant in mid May when soil conditions are suitable and fear of heavy spring frosts is past.

Main Crop: Sow about June 8. This date may be set back two weeks if irrigation is available to maintain continuous growth.

Spacing

Row spacing varies from 60-93 cm (24 to 36 in.) Sow 561g to 1.1 kg/ha (1/2 to 1 lb./acre) seed depending on seedbed conditions.

Row Spacing

Plants should be thinned to 12.5 cm (5 in.) in the row when they are 5 to 7.5 cm (2 to 3 in.) high. If a precision seeder is used, place the seed 10 cm (4 in.) apart in the row.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 for individual recommendations based on a soil test analysis.

Fertilizer is not recommended for the main storage crop. Excess fertility causes rapid growth and cracking under ideal growing conditions.

Boron Deficiency (Water-core, Brown Heart)

As a preventative measure, broadcast 22 kg/ha (20 lb./acre) borax and work in prior to seeding. A foliar spray may be used. Reduce the rate to 4.5 kg/ha (4 lb./acre). Fields to which borax has been applied should not be planted to beans or cucumbers the following year, as they are extremely sensitive to boron.

Growth Cracks

Under rapid growing conditions, the roots tend to crack at the shoulder and in severe cases the full length of the root. To prevent this, clip as much as 25% of the tops off with a rotary mower. Under very favorable conditions it may be necessary to repeat this operation. This will also prevent the crop from growing oversized before harvest for winter storage.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Refer to Weed Control - Stale Seedbed, page 11.

Preplant Incorporated

(Six to 10 days before planting).

Eptam 8-E (800 g/L)

Controls annual grasses and several broadleaf weeds (Table 1). Apply 1.32 to 1.72 L/acre in at least 45 L/acre water. Eptam must be applied to a dry soil surface of a well prepared seedbed. See Herbicide Incorporation section in the current *Guide to Chemical Weed Control* for information on incorporation.

If dry weather prevails at the time of application, do not use Eptam on sand and use the lower rate on medium and heavy soils. The level of weed control will be reduced when Eptam is used on soils which have been treated with Eptam, Eradicane or Sutan the previous growing season. It is anticipated that the reduction in control will be greater where these herbicides have been used repeatedly for two or more years.

Rival (500 g/L), Treflan EC (545 g/L)

Controls green and yellow foxtail, wild oats, and several broadleaf weeds (Table 1). Spring application only. Apply 0.65 to 1.13 L/acre Rival or 0.61 to 0.81 L/acre Treflan EC in at least 45 L/acre water. Refer to Herbicide Incorporation section in the current *Guide to Chemical Weed Control* for application and incorporation instructions. Rival and Treflan leave a residue in the soil which may affect subsequent crops. See Table 24 for a list of susceptible species in the current *Guide to Chemical Weed Control.* Trifluralin-resistant green foxtail has developed in Manitoba. Rival and Treflan will not control trifluralin-resistant foxtail. Refer to "Resistance of Weeds to Herbicides" in the current *Guide to Chemical Weed Control* for further information.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Aphids	Diazinon 500EC	0.445 L		14
	Malathion 500EC	0.566-1.214L		7
	Thimet 15 G	See label		Apply at planting
	Thiodan 480EC	0.850 L		45
Flea beetles	Ambush 500EC	0.057 L	Apply from 2 -8 leaf stage	No later than 8 leaf stage
	Diazinon	0.445 L		14
	Furadan 480F	2.125 L		40
	Malathion 500EC	0.566 - 1.214 L		7
	Sevin XLR	0.506 - 1.012 L		7
	Thiodan 4EC	0.850 L		45
Root maggots	Dasanit 15G	340 g/ 1000ft. of row	Work the graules into the top 2 cm (3/4") of soil in 15 cm (6") band, seed down center; or apply with a Gandy type applicator by placing delivery fan in front of the seed coulter. The granules are applied and incorporated by the bow wave action of the seeder.	40
band treatment	Diazinon 5G	567 g/ 1000 ft . of row		14
	Thimet 15G	777-1555 g/ 1000ft. of row		Apply at planting
Root maggots	Dasanit 7.2 EC	1.254 L	Apply as coarse spray in 10 cm (4") band over the row using single nozzle. Apply at 446-689 L/acre. See label for multiple application restrictions.	40
Drench treatment for 70 cm (28") row spacing	Diazinon 500 EC	0.911 L		14

Note: *Do not feed rutabaga refuse treated with Thiodan (endosulfan) to livestock or poultry.*

Disease Control

Clubroot

Refer to cabbage, cauliflower, brussel sprouts, broccoli Disease Control section, page 27.

Blackleg and Black Rot

Rotate crops - do not plant turnips, canola, cabbage and other cole crops more than once every three years on the same land. Sow seed which has been hot water treated for 20 minutes at 50°C.

Avoid field work when foliage is wet.

Seed Decay, Damp Off

For control use seed treated with captan or thiram.

Soft Rot

Control root feeding insects such as maggots. Avoid bruising roots as much as possible during cultivation and harvesting. Harvest under dry conditions if possible. Store close to 0°C and 95% humidity (see harvesting and storing section). If soft rot of the trimmed surface appears, trim the roots after the initial pre-soaking to remove adhering soil. Use clean water for final rinsing. Dry roots after washing and store at a cool temperature until shipped. Disinfect storage bins with a 2% copper sulphate solution or other disinfectant prior to harvest.

Brown Heart, Water-core

(See boron deficiency under Fertilizer on page 58.)

Harvesting and Storing

If possible, harvest when weather is cool and avoid bruising. Roots will store up to eight months if temperatures are held at 0°C and a relative humidity of 95%. Remove field heat as rapidly as possible to prevent shrinkage and discoloration. If forced air is used, additional moisture should be added to the air flow. Do not soak pile with water.

Trimming

When preparing roots for market, the top should be removed at the crown. Trimming into the crown should be avoided. Remove side rootlets and the main tap root below the enlarged area of the root.

Squash and Pumpkin

Varieties

Squash

Summer Squash

Green Zucchini types:

Diplomat; Zucchini; Zucchini Select; Black Jack.

Yellow Straightneck types:

Goldbar; Goldzini; Gold Rush.

Scallop types:

St. Pat Scallop.

Marrow types:

Vegetable Marrow.

Winter Squash

Acorn types:

Table Acorn.

Buttercup types:

Buttercup.

Butternut types:

Waltham Butternut.

Hubbard types:

Baby Hubbard.

Other Winter Squash:

Vegetable Spaghetti

Pumpkin

Jack O'Lantern; Funny Face; Cinderella; Big Max; Spirit; Jackpot.

Seed Treatment

Apply captan or thiram to the seed according to manufacturer's instructions.

Seeding

Squash and pumpkins are frost tender, thriving only if weather is warm. Delay seeding and transplanting until late May or early June when soil temperatures are 16°C or higher. Pumpkins and squash may be raised either from transplants, for early crops or from direct seeding in the field. About 2.2 kg/ha (2 lb./acre) of seed is required to produce enough transplants for one hectare.

Squash and pumpkin seeding rates vary somewhat with seed size for direct seeding. Large-seeded cultivars will require 1 to 1.5 kg/ha (1 to 1 1/2 lb./acre).

Suggested spacing requirements for pumpkin (standard) and winter squash: rows 1.8 to 2.5 m (6 to 8 ft.); plants 90 to 120 cm (3 to 4 ft.) apart. For pumpkin (bush) and summer squash: rows 90 to 120 cm (3 to 4 ft.); plants 60 to 90 cm (2 to 3 ft.) apart.

Sow squash/pumpkin at 2.5 cm (1 in.) depth.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See tables 4 to 7 for individual recommendations based on a soil test analysis.

When using transplants, the application of a starter fertilizer such as 10-52-17 or 10-40-10 is recommended. Mix at a rate of 454 g (1 lb.) fertilizer/45 L (10 gal.) water and apply 284 to 300 mL (10 oz.) per plant.

As a general recommendation, broadcast and incorporate 20 to 60 kg/ha (18 to 54 lb./acre) of nitrogen and 120 to 160 kg/ha (107 to 143 lb./acre) phosphorus (P_20_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_20). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. An application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended on well drained soils. For information on the application of different forms of sulphur fertilizer, see page 13.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Irrigation

See ***Cucumbers***.

Pollination

See ***Cucumbers***.

Weed Control

Cultivate between rows prior to vining. Avoid damage to root systems by using shallow cultivation and keeping a good distance from roots. Hand hoe within row.

Insect Control

See ***Cucumbers***.

Disease Control

Bacterial Wilt

Control the cucumber beetles which transmit the disease. See ***Cucumbers*** (Insect Control).

Seed Decay and Damping Off

Treat seed (if not already treated by seed company) with one of captan or thiram seed treatment fungicides.

Disease Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Angular leaf spot	Fixed copper 50W	1.821 kg	Spray at weekly intervals.	1
	Copper oxychloride 50	1.619 kg		1
Powdery mildew	Benlate 50W plus	0.223-0.344 kg	Use disease free seed and spray every 7 - 10 days	5
	Manzate 200	0.911-1.315 kg		
	Folpan 50WP	0.809 - 1.619 kg		1
	Phaltan 75W	0.506 - 1.113 kg		1
Scab	Benlate 50W plus	0.223 - 0.344 kg	Use disease free seed and spray every 7 - 10 days	5
	Manzate 200	0.911-1.315 kg		
	Bravo 500	1.942 L		1
	Bravo W75	1.315 kg		1

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Anthracnose	Benlate 50W plus	0.223-0.344 kg	Use disease free seed and spray every 7 - 10 days	5
	Manzate 200	0.911-1.315 kg		
	Bravo 500	1.295 L		1
	Bravo W75	1.315 kg		1
	Maneb 80W	0.445-1.315 kg		5
	Folpan 50WP	0.809-1.619 kg		1
	Phaltan 75W	0.506-1.113 kg		1
	Zineb 80W	0.708-1.133 kg		5
	Dithane M22	0.445-1.315 kg		5
	Ziram 85W	0.506-0.809 kg		1
	Fixed copper 50 W	1.821 kg	Spray at weekly intervals	1
	Copper oxychloride 50	1.619 kg		1
Downy mildew	Dithane M22	0.445-1.315 kg		5
	Folpan 50W	0.809-1.619 kg		1
	Phaltan 75W	0.506-1.113 kg		1
	Manzate 200	0.911-1.315 kg		5
	Fixed copper 50W	1.821 kg	Spray at weekly intervals	1
	Copper oxychloride 50	1.619 kg		1
	Zineb 80W	0.708-1.133 kg		5
Bacterial wilt	Fixed copper 50 W	1.821 kg	Spray at weekly intervals	1
	Copper oxychloride 50	1.619 kg		1
Alternaria, Septoria, and other leaf spots	Maneb 80W	0.445-1.315 kg		5
	Dithane M22	0.445 - 1.315 kg		5
	Fixed copper 50W	1.821 kg	Spray at weekly intervals	1
	Copper oxychloride 50	1.619 kg		1
	Zineb 80W	0.708-1.133 kg		5
	Ziram 85W	0.506-0.809 kg		1

Storage

Summer squash should be stored 7° to 10°C and 95% relative humidity. A storage life of 7 to 10 days can be expected. Summer squash are sensitive to chilling injury at temperatures below 7°C. Avoiding moisture loss is important.

Pumpkins and winter squash store best at 7° to 10°C and 70 to 75% relative humidity. These crops should be cured for two weeks at 25° to 30°C to aid the healing of minor injuries. After curing, temperatures should be reduced to the 7° to 10°C range. Storage life of pumpkins and squash depends largely on their type and variety.

Tomatoes

Varieties

Staking

Quick Pick; Summer Flavour 5200.

Bush

Sunny; Early Salad.

Cherry

Pixie Hyb II.

Transplants

Plants for transplanting should be strong and vigorous with no signs of disease. Planting too early should be avoided. Four to seven week-old seedlings have proven as much or more productive than older plants. Severe hardening is not recommended, as recovery is slow and delays maturity.

The number of flowers and fruit on the first two to three clusters will increase if seedlings are grown at night temperatures of 10° to 13°C for a period of 3 weeks after the first true leaf appears. This may be done before or after the first transplanting. Return the seedlings to temperatures of 15° to 18°C after this treatment.

Row Spacing

Staking - 1 m x 45 cm (3.5 ft. x 18 in.)

Bush - 1.2 m x 45 cm (4 ft. x 18 in.)

Seed Treatment

Use hot-water treated seed from a reliable seed source or apply 75% thiram or 75% captan seed protectants (if seed not already treated).

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). See Tables 4 to 7 for individual recommendations based on a soil test analysis.

To reduce the setback in transplanting, use a high phosphorus fertilizer such as 10-52-17. Mix at the rate of 454 g/45 L (1 lb./10 gal.) water and apply 284 mL (10 fluid ounces) per plant.

As a general recommendation, apply 40 to 80 kg/ha (36 to 71 lb./acre) nitrogen. Care should be taken in application of nitrogen. Too much will cause excessive vegetative growth, delayed maturity, or lack of fruit set. Broadcast and incorporate 150 to 180 kg/ha (134 to 161 lb./acre) phosphorus (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb./acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to one-fifth of above rate, and if potassium fertilizer is sidebanded, above rate can be reduced by one-half. Application of 30 kg/ha (27 lb./acre) of sulphate sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 14.

Excess nutrient levels may occur when high rates of fertilizer are used. Producers should avoid applying fertilizer at rates in excess of those recommended by a soil test. Soil sampling to a depth of 60 cm (24 in.) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

Weed Control

Preplant Incorporated

Devrinol 50-WP (50%)

Controls several annual grasses and broadleaf weeds (Table 1). Does not control established weeds. Apply 0.91 to 1.82 kg/acre. Use the lower rate on light soils (coarse textured - sandy and sandy-loam). On flat-planted or bedded crops apply before planting to well-worked soil that is dry enough to permit thorough incorporation to a depth of 2.5 to 5 cm (1 to 2 in.). Incorporate the same day as applied, using equipment which will result in uniform incorporation of the herbicide to the desired depth.

Many crops are sensitive to Devrinol residues in the soil. To avoid injury to crops (except those specified on the label) do not plant until 12 months after the last Devrinol 50-WP. Do not apply more than once per season. Spraying on ground heavily covered with leaves or trash may adversely affect weed control. Do not use on soils with over 10% organic matter.

Rival (500 g/L), Treflan EC (545 g/L)

Controls green and yellow foxtail, wild oats, and several broadleaf weeds (Table 1). Trifluralin-resistant green foxtail has developed in Manitoba. Rival and Treflan will not control trifluralin-resistant foxtail. Refer to "Resistance of Weeds to Herbicides" in the current *Guide to Chemical Weed Control* for further information. Spring application only. Apply 0.65 to 1.13 L/acre Rival or 0.61 to 0.81 L/acre Treflan EC in at least 45 L/acre water. Refer to Herbicide Incorporation section of the current *Guide to Chemical Weed Control* for application and incorporation instructions. Rival and Treflan leave a residue in the soil which may affect subsequent crops. See Table 24 in the current *Guide to Chemical Weed Control* for a list of susceptible species.

Postemergence

Fusilade (250 g/L), Fusilade II (125 g/L)

Controls several grassy weeds (Table 1). Apply the rate appropriate for the weeds to be controlled according to the following table:

Weed	Leaf Stage	Rate (L/acre)
volunteer corn	2-5	0.243
barnyard grass, volunteer wheat, volunteer barley	2-4	0.324
wild oats, proso millet	2-4	0.405
green and yellow foxtail	2-4	0.57
quackgrass suppression	3-5	0.81

Apply at the recommended leaf stage in 45 to 120 L/acre of water using flat fan nozzles and a pressure of 30 to 40 psi (200 to 275 kPa). If using Fusilade (250 g/L), add Agral 90 at a rate of 0.1 L per 100 L of spray solution. Do not add Agral 90 to Fusilade II (125 g/L). Do not apply after tillering of annual grass weeds. For quackgrass suppression in annual crops ensure that rhizomes are thoroughly fragmented by spring tillage prior to seeding. Quackgrass plants more than 20 cm (8 in.) in height or which have reached the heading stage will not be controlled. Fusilade or Fusilade II effectiveness will be reduced when plants are stressed by lack of moisture, excess moisture, flooding, low temperatures or very low relative humidity. Do not apply if rainfall is expected within 2 hours of application. Do not tank mix with other herbicides or fertilizers. Other herbicides must be applied at least 3 days after Fusilade or Fusilade II. Do not reseed sensitive crops within 60 days of application. Avoid drift onto sensitive crops (corn, cereals, forage grasses and turf). Do not graze or feed treated crops during the year of treatment. Do not apply by air. Do not apply within 60 days of harvest.

Experimental feeding studies have demonstrated that the active ingredient in this product can produce birth defects and other adverse effects in developing fetus of rats. Women capable of bearing children should be particularly careful when handling this product. Occupational exposure to this product will be reduced by strict adherence to the handling precautions and use directions provided on the product label.

Weed Resistance Note: *Fusilade/Fusilade II - resistant wild oats have been identified in a limited number of fields in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Poast (184 g/L)

Controls several grassy weeds (Table 1).

Apply:

Weed	Rate (L/acre) with Assist	Rate (L/acre) with Merge
green or yellow foxtail, barnyard grass, proso millet, witchgrass and volunteer corn	0.324 - 0.405	0.324 - 0.405
wild oats	0.57 - 0.65	0.57 - 0.65
volunteer wheat and oats	0.65	0.57 - 0.65
volunteer barley	0.65 - 0.77	0.57 - 0.65
quackgrass suppression	1.78	1.10

Where a rate range is specified for a weed, use the higher rate to control heavy infestations.

Apply Poast with Assist Oil Concentrate or Merge at 1 L/100 L spray solution in 25 to 45 L/acre water using stainless steel 80° flat fan nozzles at 40 to 45 psi (275 to 300 kPa) pressure. The use of Merge will provide more consistent annual grass control than Assist. Do not use flood jet or hollow cone nozzles. If weed infestations or crop canopy is dense, use 80 L/acre of water and 45 psi (300 kPa) pressure. Apply when the majority of annual grassy weeds are in the 2 to 5 leaf stage. Control may be reduced if grasses are not actively growing due to drought, flooding or prolonged cool periods (15°C or less).

For suppression of quackgrass, rhizomes should be thoroughly fragmented by spring tillage prior to seeding. Apply Poast at the 1 to 3 leaf stage of the quackgrass in 45 to 80 L/acre of water with Assist Oil Concentrate or Merge at 2 L/100 L spray solution. Control will be enhanced by inter-row cultivation but do not cultivate sooner than 7 days after application. Poor results will occur if the quackgrass is not actively growing at the time of treatment. Apply no later than 60 days prior to harvest. Allow at least 4 days between application of Poast and application of other chemicals. Do not seed cereals, forage grasses or corn into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to reseeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields, in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current Guide to Chemical Weed Control for further information.*

Poast + Power Pack

Controls volunteer cereals at reduced rates of Poast as well as annual grasses including green and yellow foxtail, barnyard grass and wild oats (Table 1). Apply 0.57 L/acre Poast with 1.62 L/acre Ammonium Sulphate and Assist Oil Concentrate at 1 L/100 L spray solution in 25 to 45 L/acre water when the majority of annual grasses are in the 2 to 5 leaf stage. For heavy infestations use 80 L/acre water. To mix, partially fill the tank with water. While agitating add the Ammonium Sulphate to the tank, then add the correct amount of Poast. Lastly, add the Assist and continue filling with water. Use 80° flat fan nozzles and pressures of 40 to 45 psi (275 to 300 kPa). Do not use flood jet or hollow cone nozzles. Reduced control may occur if grasses are stressed due to flooding, drought or prolonged cool conditions (15°C or lower). Apply no later than 60 days prior to harvest. Allow at least four days between application of Poast and other chemicals. Do not seed cereals, forage grasses or corn into Poast treated fields for at least 14 days following Poast application. A cultivation to a 10 cm (4 in.) depth is required 7 days prior to reseeding Poast treated fields to grass crops (such as corn, cereals or forage grasses) in the year of treatment. Ammonium Sulphate is corrosive to metal. Thoroughly clean the sprayer after use of Poast + Power Pack. Do not let this mixture stand in the tank for lengthy periods of time.

Weed Resistance Note: *Poast-resistant wild oats have been identified in a limited number of fields, in the northwest region of Manitoba. Tests indicate that these wild oats are also resistant to a number of other herbicides which are registered for wild oat control. Refer to the "Resistance of Weeds to Herbicides" section in the current guide to Chemical Weed Control or further information.*

Disease Control

Disease, Cultural Control	Pesticide & Restrictions	Product per Acre	Comments	Days to Harvest
Early & Late Blight	Bravo 500	0.971-1.619 L	Begin applications in July when first fruit reaches golf ball size or when the first signs of leaf spotting occurs. Repeat every 7-10 days.	1
	Dithane M22	1.315 kg		3
	Manzate D	0.445-1.315 kg		3
	Dithane M45	0.445-1.315 kg		1
	Manzate 200	0.708-1.315 kg		1
	Copper 50W	1.821 kg		1
	Tri-basic copper sulphate	1.619-2.833 kg		1
	Polyram 80W	0.911-1.315 kg		1
	Polyram 7D	13.15 - 16.19 kg		1
	Bravo W75	0.708 - 1.113 kg		1
	Maneb 80W	0.911 - 1.315 kg		3
	Fixed copper 53	1.619 kg		1
	Fixed copper 50W	1.821 kg		1
	Copper oxychloride 50	1.619 kg		1
	Zineb 80W	0.344-1.335 kg		5
	Ziram 85W	1.113-1.214 kg		1
Anthracnose	Bravo 500	0.971-1.619 L	Begin applications in July when first fruit reaches golf ball size or when the first signs of leaf spotting occurs. Repeat every 7-10 days.	1
	Dithane M22	1.315 kg		3
	Manzate D	0.445-1.315 kg		3
	Dithane M45	0.445-1.315 kg		1
	Manzate 200	0.708-1.315 kg		1
	Copper 50W	1.821 kg		1
	Polyram 80W	1.315 kg		1
	Tri-basic copper sulfate	1.619 - 2.833 kg		1
	Fixed copper 53	1.619 kg		1
	Zineb 80W	0.344 - 1.355 kg		5
	Folpan 50WP	1.619 kg		7
	Ziram 85W	1.113 - 1.214 kg		1
	Phaltan 75WP	0.911 kg		7
Gray Mold	Maneb 80W	0.911 - 1.315 kg		3
	Zineb 80W	0.344 - 1.355 kg		5
Blossom End Rot (Maintain uniform soil moisture throughout the growing season and avoid close cultivation).	Calcium Chloride	0.931 - 2.266 kg	Spray during the fruit development period, particularly during periods of hot humid weather. Repeat applications weekly at a lower rate.	
Bacterial Spot, Bacteria Speck (Use only seed treated in hot water at 50°C for 25 minutes. Avoid working in wet fields and avoid sprinkler irrigation. If the disease is found, do not replant tomatoes or related plants or at least 2 years).	Kocide 10 Plus	0.910 kg		3
	Maneb 80WP	0.708 - 0.910 kg		
	Coppercide plus	0.911 kg		3
	Maneb 80WP	0.708 - 0.911 kg		

Physiological Leaf Roll

This condition occurs quite often just prior to ripening of the first fruits. It is more common on staking varieties than on bush types. Symptoms are thickening of the lower leaves accompanied by a tendency to roll inwards. The leaves become very brittle and damage easily. Leaf roll may be caused by irregular water supply or severe pruning. It is a temporary condition and appears to have no effect on crop yield or quality.

Fusarium and Verticillium Wilt

Follow a crop rotation of 3 to 4 years between successive crops. Do not include peppers, eggplant, sunflowers, alfalfa, sweet clover or potatoes in the rotation. Most commercial cultivars have resistance to Fusarium and/or Verticillium wilt.

Sun Scald

See ***Peppers*** for description of injury.

Insect Control

Insect	Product	Product per Acre	Comments	Days to Harvest
Flea beetles	Ambush 500 EC	0.057-0.081 L		1
	Di-Syston 15G & LC	See label		30
	Guthion SC	0.910 - 1.416 L		2
	Malathion 500 EC	0.445 L		3
	Sevin XLR	0.506 - 1.012 L		1
	Thiodan 4EC	0.566 L		2
Variegated cutworm	Ambush 500 EC	0.057 - 0.081 L		1
	Sevin XLR	0.506 L		1
	Lannate L	0.506 - 0.911 L		1

Slugs

See slugs under ***Celery and General Pesticide Recommendations***.

Artificial Ripening of Mature Greens

For all around color, flavor and handling ability, ripen mature green tomatoes at 21°C.

Tomatoes develop their most intensive red color and flavor when held at 21°C for ripening. At temperatures above 24°C the fruit ripens on the soft side, lacking flavor, color and firmness. If they are held at temperatures below 10°C for extended periods of time, the fruit will not ripen fully even though it is returned to ideal ripening conditions. After the fruit has reached a firm/ripe stage, it may be held at temperatures of 7°C without loss of color or flavor.

Additional Information

Certified Seed Potato Producers in Manitoba

A&M Farm Ventures
Wellwood, Manitoba
ROK 2H0

Almasippi Irrigation Farms
C/O Kroeker Farms
Box 873
Portage la Prairie, Manitoba
R1N 3L6

Geortzen Bros.
Box 2290
Winkler, Manitoba
R0G 2X0

K & B Seeds Ltd.
Box 2110
Winkler, Manitoba
R0G 2X0

Kroeker Farms Ltd.
Box 1450
Winkler, Manitoba
R0G 2X0

M. J. Gowryluk & Sons Ltd.
Box 144
Holland, Manitoba
R0G 0G0

Prairie Potato Inc.
625 - 8th Street, N.W.
Portage la Prairie, Manitoba
R1N 3K5

Siemens Seed Potatoes
Box 252
Gretna, Manitoba
R0G 2V0

Southern Manitoba Potato Company
310 North Railway Ave.
Winkler, Manitoba
R6W 4B4

Swans Fleet Farms Ltd.
Bruxelles, Manitoba
R0G 0G0

Vista Farms
Box 73
Plum Coulee, Manitoba
R0G 1R0

Metric/Imperial Equivalents

Volume (liquid)

fluid ounce = 28.41 mL
pint = 0.57 litre
gallon = 4.55 litres

litre = 35.2 fluid oz
hectolitre = 26.42

Length

inch = 2.54 cm
foot = 0.3 m
yard = 0.91 m
mile = 1.61 km

millimetre = 0.04 in
centimetre = 0.39 in
decimetre = 3.94 in
metre = 3.28 ft
kilometre = 0.62 mile

Volume (dry)

cubic inch = 16.387 cm^3
cubic foot = 0.028 m^3
cubic yard = 0.765 m^3
bushel = 36.368 litres
board foot = 0.0024 m^3

cm^3 = 0.061 cu in
m^3 = 31.338 cu ft
hectolitre = 2.8 bu
m^3 = 1.308 cu yd

Proportion

1 gal/acre = 11.232 litres/ha
1 lb/acre = 1.120 kg/ha
1 lb/sq in = 0.0702 kg/cm^2
1 bu/acre = 0.898 hL/ha

1 litre/ha = 14.24 fluid oz/acre
1 kg/ha = 14.5 oz/acre
1 kg/cm^2 = 14.227 lb/sq in.
1 hL/ha = 1.112 bu/acre

Area

square inch = 6.452 cm^2
square foot = 0.093 m^2
square yard = 0.836 m^2
square mile = 2.59 km^2
acre = 0.405 ha

cm^2 = 0.155 sq in
m^2 = 1.196 sq yd
km^2 = 0.386 sq mile
ha = 2.471 acres

Weight

ounce = 28.349 g
pound = 453.592 g
hundredweight = 45.359 kg
ton = 0.907 tonne

gram = 0.035 oz
kilogram = 2.205 lb
tonne = 1.102 short ton

Temperature

°F = (°C x 1.8) + 32
°C = (°F - 32) x 5/9

Metric Measurements

Symbols

Length
mm = millimetre
cm = centimetre
m = metre
km = kilometre

Pressure
kPa = kilopascal

Area
cm_2 = sq centimetre
m_2 = square metre
ha = hectare
km^2 = sq kilometre

Weight
g = gram
kg = kilogram
t = tonne

Volume
mL = millilitre
L = litre
hL = hectolitre
m^3 = cubic metre

Temperature
°C = degrees Celsius

Measures

Length
10mm = 1 cm
100 cm = 1 m
1 000 m = 1 km

Volume
1 000 mL = 1 L
100 L = 1 hL
1 000 L = 1 m^3

Area
10 000 cm^2 = 1 m^2 (100 cm x 100 cm)
10 000 m^2 = 1 ha (100 m x 100 m)
100 ha = 1 km (1000 m x 1000 m)

Weight
1 000 g = 1 kg
1 000 kg = 1 t

Imperial Measurements

1 imperial gallon = 4 quarts = 8 pints = 160 fluid ounces
1 U.S. gallon = 5/6 imperial gallon
1 imperial quart = 40 fluid ounces
1 imperial pint = 20 fluid ounces
1 mile = 5280 feet = 1760 yards = 320 rods
1 rod = 16.5 feet = 5.5 yards
1 acre = 43,560 square feet = 4,840 square yards = 160 square rods
1 mile an hour = 88 feet/minute

Related Publications

These publications are available from the Publications Section, Manitoba Agriculture, 411 York Avenue, Winnipeg, Manitoba R3C 1M1

- Diseases of Vegetables and Special Crops (charts)
- Insect Control on Home Gardens
- Nitrogen Fixation and Legumes in Crop Production
- Soil Testing Services in Manitoba
- Micronutrients in Crop Production
- Soil Testing - 14 Common Questions
- Soil Management on Potato Land
- Manitoba Insect Control Guide

Metric Conversion Factors

Imperial units	Approx. conversion factor	Results in:
Linear		
inch	x 25	millimeter (mm
food	x 30	centimeter (cm)
yard	x 0.9	meter (m)
mile	x 1.6	kilometre(km)
Area		
square inch	x 6.5	sq. centimeter (cm2)
square foot	x 0.09	square metre (m2)
acre	x 1.6	hectare (ha)
Volume		
cubic inch	x 16	cu centimetre (cm2)
cubic foot	x 28	cubic decimetre (dm3)
cubic yard	x 0.8	cubic metre (m3)
fluid ounce	x 28	millilitre (mL)
pint	x 0.57	litre (L)
quart	x 1.1	litre (L)
gallon	x 4.5	litre (L)
bushel	x 0.36	hectolitre (hL)
Weight		
ounce	x 28	gram (g)
pound	x 0.45	kilogram (kg)
short ton (2,000 lb)	x 0.9	tonne (t)
Pressure		
pound per sq. in.	x 6.9	kilopascal (kPa)
Power		
horsepower	x 746	watt (W)
	x 0.75	kilowatt (kW)
Speed		
feet per second	x 0.30	metres per second (m/s)
miles per hour	x 1.6	kilometres per hour(km/h)
Agriculture		
gallons per acre	x 11.23	litres per hectare (L/ha)
quarts per acre	x 2.8	litres per hectare (L/ha)
pints per acre	x 1.4	litres per hectare (L/ha)
fluid oz. per acre	x 70	millilitres per hectare (mL/ha)
tons per acre	x 2.24	tonne per hectare (t/ha)
pounds per acre	x 1.12	kilograms per hectare (kg/ha)
ounces per acre	x 70	grams per hectare (g/ha)
plants per acre	x 2.47	plants per hectare (planst/ha)

Tables
One to Eight

Table 1 — Herbicides Recommended for Weed Co

Herbicides	Crops															Weeds																
	Asparagus	Beans (Snap)	Beets	Broccoli, Brussel Sprouts	Cabbage, Cauliflower	Carrots	Celery	Corn (Sweet)	Cucumbers (Fresh)	Onions	Parsnips	Peppers	Potatoes	Rutabagas	Tomatoes	Barnyard Grass	Bindweed (Field)	Blue Bur	Buckwheat, Tartary	Buckwheat, Wild	Catchfly (Night Flowering)	Chickweed, Common	Cocklebur	Cow Cockle	Flixweed	Foxtail (Green)	Foxtail (Yellow)	Goosefoot (Oak Leaved)	Groundsel, Common	Hemp Nettle	Knotweed (Prostrate	Kochia
Afolan F, Lorox, Linuron 400 L	X						X[1]				X[9]					●				●		●				S	S	●			●	
AWK #1						X					X					●										●	●					
Alanap 3									X								●					●	●			●	●					
Bar-Fox, TCA			X																							●	●					
Basagran		X						X									●					●	●						●			
Buctril M								X										●	●	●	●		●	●	●				●			●
Devrinol 50WP [5]															X	●						●				●	●		●		●	
2,4-D	X							X									☐	●					●		•			●				
Dual								X					X			●										●	●					
Dyanap									X							●										●	●					
Eptam		X											X	X		●						●				●	●					
Eradicane 8-E								X								●						●				●	●					
Excel				X[6]	X					X			X			●										●	●					
Fusilade, Fusilade II						X				X			X		X	●										●	●					
Goal [3]										X										●								●				
Gramoxone (pre to crop)	X												X			Controls Annual																
Gramoxone (stale seedbed)		X	X	X[4]	X[4]	X		X	X	X			X	X		Controls Annual																
Gramoxone (pre to crop) + Lexone DF													X			Controls Annual																
Hoe-Grass 284		X				X				X[3]			X			●										●	●					
Karmex	X																									●						
Kil-Mor								X									☐	O	●	●	O		●	●	●						●	●
Pardner								X											●	●	●			●					●			●
Poast		X							X	X			X		X	●										●	●					
Prefar									X							●										●	●					
Primextra[2]								X								●				●						●	●					
Princep Nine-T, Simazine 80W/Simadex 80W	X															●				●							●					
Rival, Treflan EC[7]	X	X		X	X	X						X		X	X	●				●		●		●		●[d]	●[d]				●	
Ro-Neet 7.2E			X													●										●	●					
Roundup, Laredo, Wrangler (pre to crop)													X			Controls Annual																
Sencor, Lexone	X[8]												X						●			●								●		
Secor or Lexone + Eptam													X			●						●				●	●			●		

Legend: Herbicides and Crops

X — Recommended on crop.

[1] — Afolan only.

[2] — These treatments may remain as a residue in the soil the following year. Flax, peas,fababeans and triazine tolerant canola are more tolerant crops. see comments on corn section for more specific instructions.

[3] — Dry bulb onion only.

[4] — For use on cabbage, cauliflower and brussel sprouts only.

[5] — Doesn't control established weeds. To avoid injury to crops not specified on label, do not plant until 12 months after last application.

[6] — Broccoli only.

[7] — Spring application only.

[8] — Sencor only.

[9] — Afolan · Linaron 400 L only

Legend: Weeds

● — Controlled by maximum rates recommended for the weed may not appear on both labels.

S — Suppression

O — Not labelled for control but adequate control can

☐ — Top growth control only.

• — Controlled by rates less than the maximum recon

a — Split application required for adequate control.

b — Regrowth can be expected.

c — Except Triazine Tolerant Canola.

d — Some strains of the weed are resistant to the trea

e — Barley only

or Weed Control in Vegetable Crops

y (Night Flowering)	Chickweed, Common	Cocklebur	Cow Cockle	Flixweed	Foxtail (Green)	Foxtail (Yellow)	Goosefoot (Oak Leaved)	Groundsel, Common	Hemp Nettle	Knotweed (Prostrate)	Kochia	Lamb's Quarters	Lettuce (Prickly)	Mustard (Ball)	Mustard (Dog)	Mustard (Hare's Ear)	Mustard, Indian	Mustard, Tumble	Mustard, Wild	Mustard, Wormseed	Pigweed, Prostrate	Pigweed, Red Root	Pigweed, Russian	Pigweed, Tumble	Purslane	Quackgrass	Ragweed, Common	Ragweed, False	Ragweed, Giant	Shepherd's Purse	Smartweed, Lady's Thumb	Sow Thistle (Annual)	Sow Thistle (Perennial)	Stinkweed	Thistle, Canada	Thistle, Russian	Volunteer Corn	Volunteer Rapeseed	Volunteer Wheat, Barley	Wild Oats
	●				S	S	●			●		●								●	O	●			●		●	●	●	●	●	●		●						
					●	●						●										●			●															●
	●	●			●	●						●										●			●		●	●	●											
					●	●																																		
	●	●						●				●							●			●			●		●		●		●				O^{a}	●				
		●	●	●				●			●	●		●					●	●	O	●					S			●	●	O	□^{b}	●	□^{b}	●		●		
	●				●	●		●		●		●										●			●							●								●
		●		•			●					•	●	•	●	•	•	•	•	•			•	O			•	•	•	•		●	□	•	□	●		O		
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							●					●										●			●															
Controls Annual Weed Seedlings and Top Growth of Perennial Weeds																																								
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					●	●																															●			●^{c}
					●							●										●					●													
		●	●	●						●	●	●		●	●	●	●	●	●	●	●	●					●	●	●	●	●	●	□	●	□	●		O		
			●					●			●	●							●								●				●			●		●				
					●	●																				S											●		●	●^{c}
					●	●																																		
					●	●						●							●	●	●				●		●				●									
						●						●													●		●	●	●	●										●
	●		●		●^{d}	●^{d}				●		●										●			●											●				●
					●	●						●										●			●															●
Controls Annual Weed Seedlings and Top Growth of Perennial Weeds																																								
	●								●			●		●					●			●								●	●			●				●^{f}		
	●				●	●			●			●							●		●	●		●	●	S					●			●				●^{f}		●

y maximum rates recommended for crops. Where two brand names are recommended,
ıy not appear on both labels.

for control but adequate control can be expected.

control only.

y rates less than the maximum recommended for crops.

tion required for adequate control.

ın be expected.

ine Tolerant Canola.

s of the weed are resistant to the treatment and will not be controlled.

Using Pesticides?

Protect Yourself!!

DANGER POISON
High Hazard requires goggles, respirator, gloves and skin protection. Avoid fumes and spray mist.

WARNING POISON
Moderate Hazard requires goggles, gloves and skin protection. Avoid fumes and spray mist.

CAUTION POISON
Low Hazard requires gloves and skin protection. Avoid fumes and spray mist.

Table 2 - Insecticides Recommended for Insect Control in

Insecticides	Crops: Cabbage, Cauliflower, Brussel Sprouts, Broccoli	Carrots	Celery	Corn (Sweet)	Cucumbers, Pumpkins, Squash	Eggplant	Lettuce	Onions	Peppers	Potatoes	Radish	Rutabagas	Tomatoes							nsects: Aphids	Cabbage Looper	Cabbage Worm	Colorado P	Cor
Ambush	X			X						X	X	X	X								●	●	●	●
Bacillus Thuringiensis	X																				●	●		
Belmark	X^3									X										●	●	●	●	
Cygon	X						X		X	X		X								●				
Cymbush	X		X	X				X		X											●	●	●	
Supracide										X													●	
Decis	X									X											●	●	●	
Diazinon	X	X			X^c		X	X	X	X	X	X								●	●	●	●	
Di-syston	X					X	X		X	X			X							●			●	
Dyfonate								X^6		X														
Furadan		X		X				X^6		X		X								●			●	
Guthion	X				X^b					X		X	X							●	●	●	●	
Lannate	X			X						X			X							●	●	●		●
Lorsban	X^4							X		X													●	
Malathion	X	X	X		X	X	X	X	X	X	X	X	X							●	●	●	●	
Metaldehyde[2]			X	X			X						X											
Monitor	X									X										●	●	●	●	
Ripcord	X			X				X		X											●	●	●	●
Rotenone	X^5			X	X								X							●	●	●	●	
Sevin	X	X	X	X	X	X	X			X	X	X	X								●	●	●	●
Thimet							X			X		X								●			●	
Thiodan	X		X	X	X	X			X	X		X	X							●	●	●	●	●

Note

- Refer to specific crop sections for insects controlled, and to determine recommended product formulation, rates and preharvest wait periods.
- Apply according to label directions.

Legend

X — Registered for crops.
● — Insects controlled at recon
a — Do not use on green bunc
b — For use on cucumbers an
c — For use on cucumbers an
1 — Flea beetle control in pota
2 — Refer to Insect Control, pa
3 — Belmark is not registered
4 — Do not use on brussel spr
5 — For use on cabbage and c
6 — For use on cooking and s
7 — For use on dry bulb and p

ct Control in Vegetable Crops

nsects

Aphids	**Cabbage Looper**	Cabbage Worm	**Colorado Potato Beetle**	Corn Earworm	**Cucumber Beetle**	Cutworm	**Cutworm, Variegated**	Diamond Back Moth Larvae	**European Corn Borer**	Flea Beetle	**Leaf Hopper**	Maggot Flies	**Onion Maggots**	Onion Maggot Flies	**Pepper Maggot**	Potato Leaf Hopper	**Radish Maggot**	Root Maggots	**Slugs**	Tarnished Plant Bug	**Thrips**	Wireworm
	●	●	●	●		●[2]	●	●	●	●						●						
	●	●						●														
●	●	●	●					●		●[1]	●					●						
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	●	●	●					●	●	●	●			●		●						
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●	●	●	●		●	●[2]		●		●	●	●	●	●		●	●	●			●[4]	
●			●							●	●					●						
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			●			●[2]				●			●[2,7]					●[4]				
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●			●							●	●					●		●				
●	●	●	●	●	●			●		●	●				●	●				●		

Legend

X — Registered for crops.

● — Insects controlled at recommended rates.

— Do not use on green bunching onions.

— For use on cucumbers and pumpkin.

— For use on cucumbers and squash.

— Flea beetle control in potatoes only.

— Refer to Insect Control, page 10.

— Belmark is not registered for broccoli.

— Do not use on brussel sprouts.

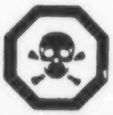
— For use on cabbage and cauliflower only.

— For use on cooking and seeded spanish onions only.

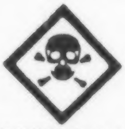
— For use on dry bulb and pickling onions only.

Using Pesticides?

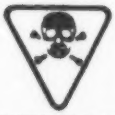
Protect Yourself!!



DANGER POISON
High Hazard requires goggles, respirator, gloves and skin protection. Avoid fumes and spray mist.



WARNING POISON
Moderate Hazard requires goggles, gloves and skin protection. Avoid fumes and spray mist.



CAUTION POISON
Low Hazard requires gloves and skin protection. Avoid fumes and spray mist.

Table 3 — Fungicides Recommended for Dis

Fungicide	Crop																			Disea		
	Asparagus	Beans (snap)	Beets (Red)	Cabbage, Cauliflower, Brussel Sprouts, Broccoli	Carrots	Celery	Corn (Sweet)	Cucumbers	Eggplant	Lettuce	Onions	Peppers	Potatoes	Pumpkin, Squash, Melon	Radish	Rutabagas	Tomatoes			Angular Leaf Spot (Cucum	Angular Leaf S	An
Benlate 50W	0[e]	14																				
Bravo 500, Bravo W75				7	1	7		1					1	1			1					
Botran 75W		2																				
Coppercide		1						1				1								●		
Copper 53, Fixed Copper 50W, Fixed Copper Oxychloride 50				1		1		1			1		1	1			1			●	●	
Kocide 101		1						1				1								●		
Copper 50W, Tribasic Copper Sulfate		1		1	1	1		1	1			1	1				1			●	●	●
Captan (seed treatment)		X	X	X	X	X	X	X	X		X[f]	X	X	X	X	X	X					
Dithane M-45, Manzate 200					7	14					10		X				7					
Dithane M-22, Manzate D, Maneb 80W				7	5	14		5	5	7	10	5	1	5			3					
Dyrene 50WP						7					7											
Easout													X									
Folpan 50WP						7		1						1			7					
Mertect													X[b]									
Phaltan 75 WP						7		1						1			7					
Polyram DF, Polyram 7D, Polyram 80W	0[a]				5	14							X				7					
Pro-Grow (seed treatment)											X											
Rovral 50WP		14									15[c]											
Thiram (seed treatment)		X	X	X	X		X	X	X	X	X	X		X	X	X	X					
Vitaflo 280 (seed treatment)		X					X															
Zineb 80W	0[a]	7		7	7	14		5	5	10	7	5	1	5			5					●
Ziram 85W								1						1			1					
Benlate & Manzate 200								5						5								
Coppercide & Maneb 80WP																	3					
Kocide & Maneb 80WP																	3					

Legend

O	— Recommended for use on crop
X	— Recommended on crop as a seed treatment
●	— Indicates disease controlled
1 to 15	— Numbers indicate recommendation for crop and days between last spray and h
a	— Do not apply to asparagus spears prior to cutting, apply to plant after cutting
b	— Post harvest tuber treatment
c	— Dry bulb only
d	— Blast only
e	— Use as a root dip
f	— Used for pelleted seed only

Note

Refer to specific crop sections for diseases controlled and to determine recommended prod

for Disease Control in Vegetable Crops

Diseases

Tomatoes	Angular Leaf Spot (Cucumbers)	**Angular Leaf Spot (Melon, Pumpkin, Squash)**	Anthracnose (Beans)	**Anthracnose & Leafspots (Cucumber)**	Anthracnose & Leafspots (Melons, Pumpkin, Squash)	**Asparagus Crown Rot**	Bacterial Blight (Beans)	**Bacterial Spot, Bacterial Speck (Tomatoes)**	Bacterial Spot, Bacterial Speck (Peppers)	**Bacterial Wilt (Cucumbers, Pumpkins, Melons, Squash)**	Blast, Purple Blotch Gray Mold (Onions)	**Downy Mildew (Broccoli, Cauliflower, Cabbage, Lettuce)**	Downy Mildew (Onions)	**Downy Mildew (Cucumber, Melons, Pumpkin, Squash)**	Dry Rot (Potatoes)	**Early & Late Blight (Carrots)**	Early & Late Blight (Celery)	**Early Blight, Leaf Spot, Anthracnose (Tomato)**	Early & Late Blight (Egg Plant, Peppers)	**Early & Late Blight & Leaf Spot (Potato)**	Gray Mold (Tomatoes)	**Head Smut (Corn)**	Powdery Mildew (Cucumbers)	**Powdery Mildew (Melons, Pumpkin, Squash)**	Rust (Asparagus)	**Scab (Cucumbers)**	Scab (Melon, Pumpkin, Squash)	**Seed Decay & Damp Off**	Seed Piece Diseases (Potato)	**Smut (Onions)**	White Mold (Beans)
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and days between last spray and harvest
tting; apply to plant after cutting.

Using Pesticides?
Protect Yourself!!

DANGER POISON	WARNING POISON	CAUTION POISON
High Hazard requires goggles, respirator, gloves and skin protection. Avoid fumes and spray mist.	Moderate Hazard requires goggles, gloves and skin protection. Avoid fumes and spray mist.	Low Hazard requires gloves and skin protection. Avoid fumes and spray mist.

d to determine recommended product formulation and rates

Table 4 — Nitrogen Recommendations For Vegetable Crops

(Recommendations Based On Procedures Used By The Provincial Soil Testing Laboratory)

Crop	Nitrogen (N) Recommendations kg/ha (lb/acre)							
	Soil Nitrate-Nitrogen Content to 60 cm (24 in) kg/ha (lb/acre)							
	0–25 (0–22)	**26–50 (23–45)**	**51–70 (46–62)**	**71–90 (63–80)**	**91–100 (81–89)**	**101–110 (90–98)**	**111–130 (98–116)**	**131–140 (116–125)**
● Set and Pickling Onions ● Radishes ● Beets ● Rutabagas	50–100 (45–89)	0–49 (0–44)	0	0	0	0	0	0
● Asparagus at establishment ● Beans ● Carrots ● Parsnips ● Vine crops including Cucumber, Squash, Pumpkin	90–140 (80–123)	40–89 (36–79)	0–39 (0–35)	0	0	0	0	0
● Corn ● Egg Plant ● Garlic ● Cooking Onions ● Peppers ● Tomatoes	130–180 (116–160)	80–129 (71–115)	79–40 (36–70)	0–39 (0–35)	0	0	0	0
● Established Asparagus ● Endive ● Lettuce ● Spinach	150–200 (134–178)	100–149 (89–133)	60–99 (54–88)	20–59 (18–53)	0–19 (0–17)	0	0	0
● Broccoli ● Brussel Sprouts ● Summer Cabbage ● Cauliflower	170–220 (151–196)	120–169 (107–150)	80–119 (71–106)	40–79 (36–70)	20–39 (18–35)	0–19 (0–17)	0	0
● Storage (Winter) Cabbage	210–260 (187–232)	160–209 (143–186)	120–159 (107–142)	80–119 (71–106)	60–79 (54–70)	40–59 (36–53)	0–39 (0–35)	0
● Celery	230–280 (205–250)	180–229 (160–204)	140–179 (125–159)	100–139 (89–124)	80–99 (71–88)	60–79 (54–70)	20–59 (18–53)	0–19 (0–17)
● Potatoes*	77–100 (67–89)	53–76 (47–68)	35–52 (31–46)	35 (31)	35 (31)	35 (31)	35 (31)	35 (31)

Note

*For the above crops except potatoes, if the nitrate nitrogen content of the 0–15 cm (0–6 in) sample is less than 20 kg/ha (18 lb/acre), a minimum recommendation of 40 kg/ha (36 lb/acre) fertilizer N will be made regardless of the total nitrate content.

For all of the above crops, if the nitrate content in the 15–60 cm (6–24 in) range exceeds 125 kg/ha (112 lb/acre), the following comment is printed on the soil test report: "Nitrate-nitrogen in the lower soil depth is extremely high; probably reflecting an accumulation from past applications of high rates of nitrogen fertilizer. Soil testing should continue on an annual basis to monitor this situation and to determine sound fertilizer nitrogen application rates."

Table 5 — Phosphorus Recommendations For Vegetable Crops

(Recommendations Based On Procedures Used By The Provincial Soil Testing Laboratory)

Crop	**Phosphate (P_2O_5) Recommendations kg/ha (lb/acre)**					
	Available Phosphorus (P) to 15 cm (6 in) soil depth kg/ha (lb/acre)					
	Very Low 0-11 (0-10)	**Low 12-19 (11-17)**	**Medium 20-28 (18-25)**	**High 29-40 (26-36)**	**Very High 41-100 (37-89)**	**Very High+ 100+ (89+)**
● Asparagus ● Beans ● Beets ● Carrots ● Corn ● Endive ● Garlic ● Lettuce ● Onions ● Parsnips ● Peas ● Radishes ● Rutabagas ● Spinach ● Vine Crops including Cucumbers, Pumpkins and Squash	178-200 (159-178)	162-177 (144-158)	144-161 (128-143)	120-143 (107-127)	0-119 (0-106)	0 0
● Broccoli ● Brussel Sprouts ● Cabbage ● Cauliflower ● Celery ● Eggplant ● Pepper ● Tomatoes	222-250 (198-223)	202-221 (180-197)	180-201 (160-179)	150-179 (134-160)	0-149 (0-133)	0 0
● Potatoes*	60 (54)	53-59 (47-53)	45-52 (40-46)	36-44 (32-39)	35 (31)	35 (31)

Note

*For all crops except potatoes, above rates are based on phosphate fertilizer being applied as broadcast and incorporated. If the phosphate fertilizer is to be sidebanded, the rates can be reduced to one-fifth above rates.

For potatoes, the above rates are based on phosphate fertilizer being sideband applied at time of planting.

Table 6 — Potassium Recommendations For Vegetable Crops

(Recommendation Based On Procedures Used By The Provincial Soil Testing Laboratory)

Crop	**Potassium (K_2O) Recommendations kg/ha (lb/acre)**					
	Available Potassium (K) to 15 cm (6 in) soil depth					
	Very Low 0-95 (0-85)	**Low 96-191 (86-170)**	**Medium 192-287 (171-256)**	**High 288-383 (257-342)**	**Very High 384-450 (343-401)**	**Very High+ 451+ (402+)**
● Bean ● Peas	70 (62)	35 (31)	0 0	0 0	0 0	0 0
● Beets ● Carrots ● Corn ● Endive ● Egg Plant ● Garlic ● Lettuce ● Onions ● Parsnips ● Pepper ● Radishes ● Spinach ● Tomatoes ● Vine Crops including Cucumber, Pumpkin, Squash	178-225 (156-201)	134-177 (120-157)	82-133 (73-119)	34-81 (30-72)	0-33 (0-29)	0 0
● Broccoli ● Brussel Sprouts ● Cabbage ● Cauliflower ● Celery ● Rutabagas	237-300 (211-268)	173-235 (154-210)	109-172 (97-153)	49-108 (44-96)	0-48 (0-43)	0 0
● Asparagus	335-425 (299-379)	245-334 (218-298)	154-244 (137-217)	63-153 (56-136)	0-62 (0-55)	0 0
● Potatoes*	95-110 (85-98)	78-94 (70-84)	62-77 (55-69)	47-61 (42-54)	0-46 (0-41)	0 0

Note

*For all crops except potatoes, above rates are based on potassium fertilizer being applied as broadcast (and incorporated if feasible).

For potatoes, the above rates are based on potassium fertilizer being sideband applied at time of planting. If sideband application is not feasible, the above potassium fertilizer rate should be doubled, broadcast applied and incorporated.

Table 7 — Sulphur Recommendations For Vegetable Crops

(Recommendations Based On Procedures Used By The Provincial Soil Testing Laboratory)

Soil Sulphate – Sulphur Content to 60 cm (24 in) kg/ha (lb/acre)	Category	Sulphur Recommendation – All Vegetable Crops kg/ha (lb/acre)
0–11 (0–10)	Very Low	30 (27)
12–22 (11–20)	Low	30 (27)
23–33 (21–29)	Medium	30 (27)
34–44 (30–39)	High	0 0
45–66 (40–59)	Very High	0 0
67+ (60+)	Very High+	0 0

Note

Sulphur fertilizer recommendations are based on sulphur being applied in the sulphate (SO_4) form since it is the only form readily available to plants

Table 8 — Vegetable Seed: Number of Seeds per Gram (Ounce) and Storage Longevity

Vegetable	Average Number of Seeds per Grams	(Oz.)	Relative Longevity – Years
Asparagus	49	(1,400)	3
Bean, Lima	1 to 3	(20 to 70)	3
Bean, Snap	4	(100)	3
Beet	71	(2,000)	4
Broccoli	286	(8,100)	3
Brussel Sprouts	300	(8,500)	4
Cabbage	272	(7,700)	4
Carrot	776	(22,000)	3
Cauliflower	303	(8,600)	4
Celeriac	1,760	(50,000)	3
Celery	2,680	(76,000)	3
Chicory	705	(20,000)	4
Chinese Cabbage	250	(7,000)	3
Cucumber	39	(1,100)	5
Eggplant	254	(7,200)	4
Endive	600	(17,000)	5
Kale	353	(10,000)	4
Kohlrabi	325	(9,200)	3
Leek	349	(9,900)	2
Lettuce	917	(26,000)	5
Muskmelon	39	(1,100)	5
New Zealand Spinach	15	(430)	3
Okra	18	(500)	2
Onion	300	(8,500)	1
Parsley	635	(18,000)	1
Parsnip	240	(6,800)	1
Pea	2 to 8	(50 to 230)	3
Pepper	159	(4,500)	2
Pumpkin	7	(200)	4
Radish	109	(3,100)	4
Rutabaga	388	(11,000)	4
Salsify	71	(2,000)	1
Spinach	102	(2,900)	3
Squash	6 to 13	(180 to 380)	4
Sweet Corn	5	(140)	2
Swiss Chard	53	(1,500)	4
Tomato	353	(10,000)	3
Turnip	494	(14,000)	4
Watermelon	11	(320)	4

Source: Harrington and Minges (1954)